UNIV
OF MICHIG.
JAN 28 1952
ENGINEERING
LIBRARY

JANUARY, 1952
No. 179

ASTM Bulletin

NEWS—Important Achievements in 1951; New Publications; Metal Powders Symposium at Spring Committee Week; Marburg and Gillett Lecturers.

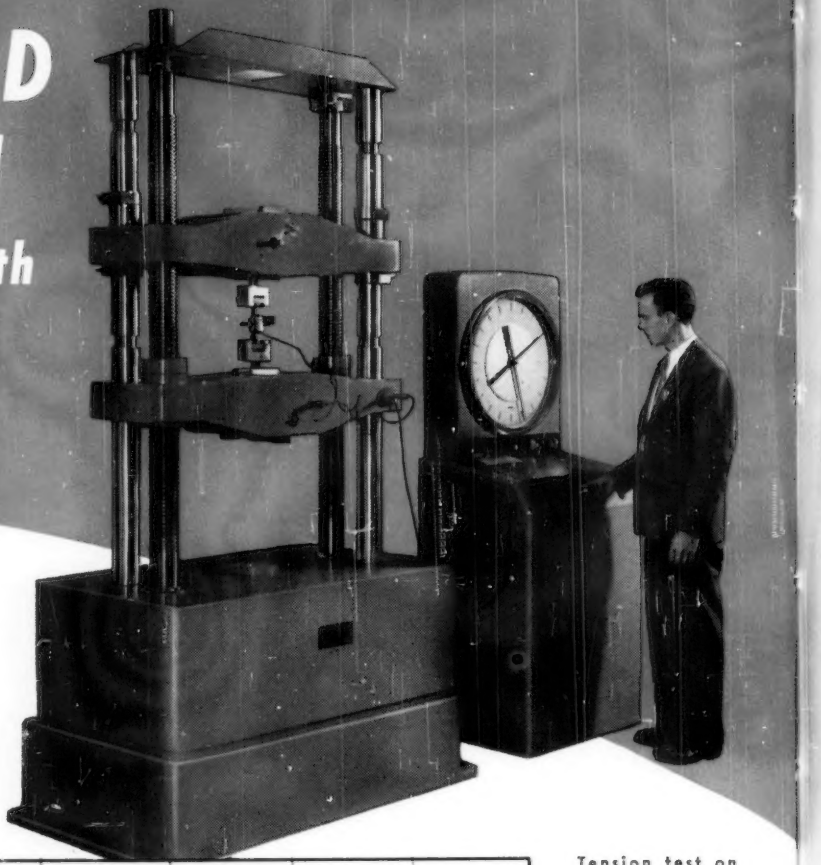
PAPERS—Autoclave Test for Glazed Whitewares; Motor Mount Testing; Test Method Fundamentals; Schnadt Notch Toughness Test; Measurement of Iron Losses; Adhesive Bonding of Aluminum Joints; Electron Metallurgy.

American Society for Testing Materials

PRECISE LOAD INDICATION

For All Your Tests With

5 SCALE RANGES



Only Riehle Universal Testing Machines give you 5 SCALE RANGES — the equivalent of 5 separate testing machines in one. 5 scale ranges provide complete coverage of the machine's full capacity and permit you to select the one range most applicable for any given test. Each range is covered by a single revolution of the dial pointer.

RIEHLE HYDRAULIC UNIVERSAL TESTING MACHINES

Model	Range 1 From 0 to	Range 2 From 0 to	Range 3 From 0 to	Range 4 From 0 to	Range 5 From 0 to
PH-10	10,000	5,000	2,500	1,000	500
PH-20	20,000	10,000	5,000	2,000	1,000
PH-30	30,000	15,000	6,000	3,000	1,500
PH-60	60,000	30,000	12,000	6,000	3,000
PH-120	120,000	60,000	30,000	12,000	6,000
PH-200	200,000	100,000	50,000	20,000	10,000
PH-300	300,000	150,000	60,000	30,000	15,000
PH-400	400,000	200,000	80,000	40,000	20,000

Tension test on Riehle 120,000 lbs. Hydraulic Universal. Photo courtesy Cleveland Tank Plant, Cadillac Motors Corp.

CONSTANT ACCURACY — Riehle Universals are guaranteed to be within one half the normal tolerance allowed by ASTM and Federal specifications.

SINGLE DIAL CONTROL — One dial controls speeds for the complete testing cycle, from fast forward to fast return.

LOW TABLE AND GRIPPING HEAD — Provide easy access to testing tools and specimens.

EASY TO INSTALL — Riehle Universals are floor level units, requiring no installation pits.

NEW! 32-PAGE CATALOG

A complete book on all Riehle Hydraulic Universal Testing Machines, including illustrations, specifications, advantages, operating details. Send for your copy today!

Riehle Testing Machines Division
AMERICAN MACHINE AND METALS, INC.
Dept. AS-152, East Moline, Illinois

Without obligation, please send new catalog on Riehle Hydraulic Universal Testing Machines.

Firm Name _____

Address _____

City _____ Zone _____ State _____

Name and Title _____

RIEHLE TESTING MACHINES
Division of
AMERICAN MACHINE AND METALS, INC.
East Moline, Illinois
Representatives in Principal Cities
FOREIGN SALES OFFICE: Woolworth Building, New York 7, N. Y.

"ONE TEST IS WORTH A THOUSAND EXPERT OPINIONS"

Reg. U. S. Pat. Off.

OFFICERS

Board of Directors

President

T. S. Fuller

Vice-Presidents

H. L. Maxwell — L. C. Beard, Jr.

Directors

Term ending 1952	*Term ending 1953*
R. D. Bonney	B. A. Anderton
C. H. Fellows	R. H. Brown
H. F. Gonnerman	D. K. Crampton
N. L. Mochel	H. G. Miller
M. O. Withey	J. R. Trimble

Term ending 1954

J. W. Bolton
R. A. Schatzel
E. O. Slater
Stanton Walker
F. P. Zimmerli

Past-Presidents

R. L. Templin — J. G. Morrow
L. J. Markwardt

Executive Secretary
C. L. Warwick

COMMITTEE ON PAPERS AND PUBLICATIONS

This committee has authority in all matters affecting the acceptance, rejection, editing and publication of papers, committee reports, and discussions. The committee also acts in an advisory capacity to the Board of Directors in publication matters in general.

C. L. Warwick, *Chairman*

R. C. Adams — L. A. Melsheimer
H. C. Cross — H. K. Nason
A. G. H. Dietz — L. S. Reid
G. R. Gohn — C. H. Sample
K. B. Woods

Correspondent Members from Pacific Coast District

F. J. Converse — R. E. Davis

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

ASTM Bulletin, January, 1952. Published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, $2.75; two years, $4.75; three years, $6.50; Canada, one year, $3.25; two years, $5.75; three years, $8.00. Other countries, one year, $3.75; two years, $6.75; three years, $9.50. Single Copies—50 cents. Number 179. Entered as second class matter April 8, 1940, at the post office at Easton, Pa., under the act of March 3, 1879.

Copyrighted, 1952, by the American Society for Testing Materials.

ASTM BULLETIN

Published by
AMERICAN SOCIETY for
TESTING MATERIALS
1916 Race St., Philadelphia 3, Pa.
1902—50th Anniversary—1952

This Issue Contains

Progress on Many Fronts in 1951 ASTM Research and Standardization..... 5–13
Wanted: Part 1, 1949 Book of ASTM Standards..... 9
1952 Book of Standards to Be in Seven Parts..... 15
Standard Autoclave Test for Glazed Whiteware Products, *by John H. Koenig*... 51
Motor Mount Testing Machine, *by Lloyd Muller*..... 53
Fundamentals of a Test Method, *by Gilbert L. Peakes*..... 57
The Notch Toughness Test of Henri Schnadt, *by Wendell P. Roop*..... 61
Laboratory Measurement of Iron Losses at Audio Frequencies, *by C. C. Horstman and A. Lucic*..... 64
Fatigue Tests Under Axial Loads of Aluminum Joints Bonded with a Resinous Adhesive, *by W. N. Findley, B. A. Century, and C. P. Hendrickson*..... 67
A Technique for Making Strain-Free Replicas for Electron Metallography, *by William L. Grube and Stanley R. Rouze*..... 71
Discussion of Paper of Calculation of Air Bubble Size Distribution from Results of a Rosiwal Traverse of Aerated Concrete..... 73

NEWS ABOUT THE SOCIETY AND ITS COMMITTEES:

New and Revised Standards..... 14
1952 Book of Standards in Seven Parts..... 15
Many New ASTM Publications—Sandwich Constructions; Corrosion Testing; Fatigue; Thermal Insulating; Bulk Sampling; Triaxial Testing (Soils); Portland Cement; Soaps and Detergents; Electrical Contacts.....16–20
Spring Meeting Symposium on Testing Metal Powders..... 21
Notes on Fiftieth Anniversary Meeting..... 23
ASTM 25 and 50 Years Ago..... 25
Theme and Slogan Contest—New York Committee Wants Your Ideas..... 25
District Activities..... 26

MISCELLANEOUS NEWS NOTES:

Calendar of Society Events..... 24
News Notes on Laboratory Supplies and Testing Equipment, Instrument Company News.....44–46
Book Reviews.....47–48
Dollar Savings Through Standards 48
Some Unsolved Problems—Interesting Research.....28, 29
Conservation of Nickel, by George R. Gohn..... 32
Technical Committee Notes—C-11, C-18, C-21, D-9, D-10, D-20, D-21, E-1 (Laboratory Equipment), Automotive Rubber.....33–39
Society Buys Ground, Growing Membership, Sustaining Membership..... 40
Technical Matters—Changes in High-Temperature Steel Specifications, Procedure for Government Standards, Bolting Errata, and Safety Precautions..20, 31, 35, 40
Personals, New Members, Necrology, Appointments.....41–43
Notes on High-Temperature Papers, Bureau of Standards, Nylon, Miscellaneous Technical News, and Secretary Go to Heaven?...49, 50
Index to Advertisers..... 87

ASTM Bulletin is indexed regularly by Engineering Index, Inc.

Telephone: Rittenhouse 6-5315 — Cable Address: Testing, Philadelphia

JANUARY—1952

No. 179

Buehler...

...OFFERS A COMPLETE LINE OF EQUIPMENT FOR THE Metallurgical Laboratory

Buehler specimen preparation equipment is designed especially for the metallurgist, and is built with a high degree of precision and accuracy for the fast production of the finest quality of metallurgical specimens.

1. No. 1315 Press for the rapid moulding of specimen mounts, either bakelite or transparent plastic. Heating element can be raised and cooling blocks swung into position without releasing pressure on the mold.

2. No. 1211 Wet power grinder with 3/4" hp. ball bearing motor totally enclosed. Has two 12" wheels mounted on metal plates for coarse and medium grinding.

3. No. 1000 Cut-off machine is a heavy duty cutter for stock up to 3-1/2". Powered with a 3 hp. totally enclosed motor with cut-off wheel, 12" x 3/32" x 1-1/4".

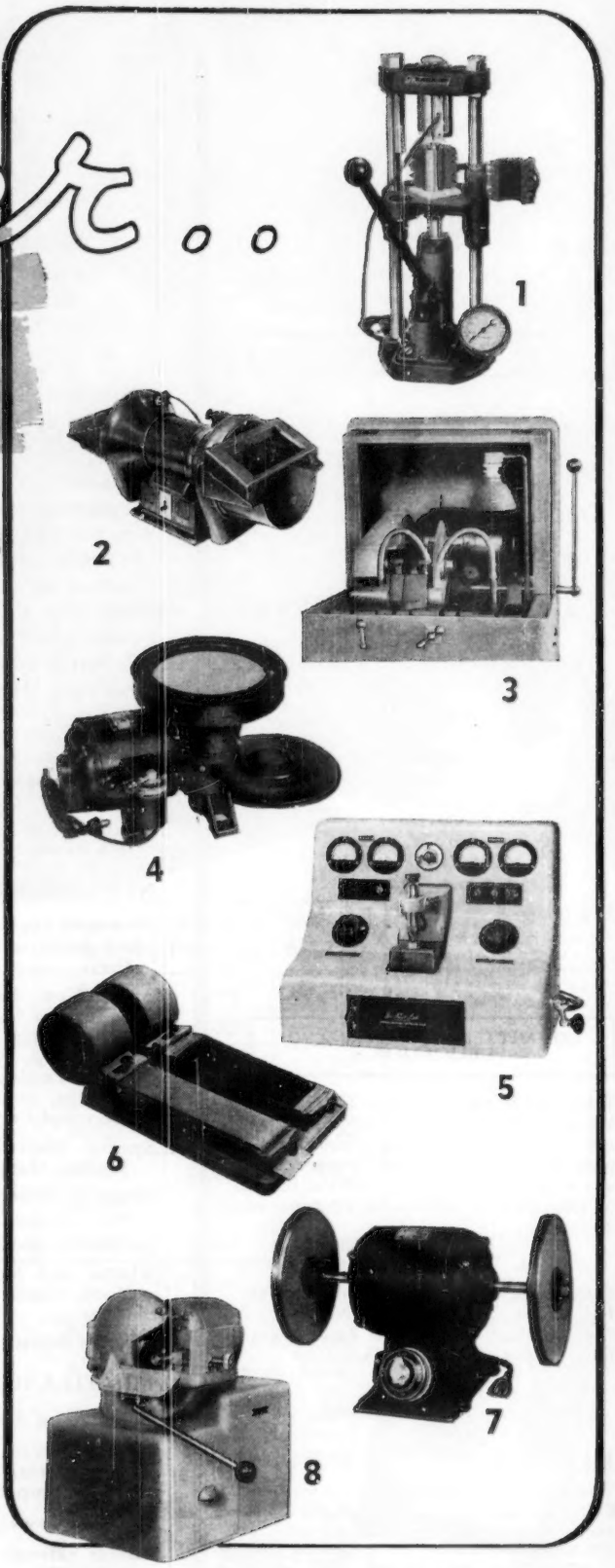
4. 1505-2AB Low Speed Polisher complete with 8" balanced bronze polishing disc. Mounted to 1/4 hp. ball bearing, two speed motor, with right angle gear reduction for 161 and 246 R.P.M. spindle speeds.

5. No. 1700 New Buehler-Waisman Electro Polisher produces scratch-free specimens in a fraction of the time usually required for polishing. Speed with dependable results is obtained with both ferrous and non-ferrous samples. Simple to operate—does not require an expert technician to produce good specimens.

6. No. 1410 Hand Grinder conveniently arranged for two stage grinding with medium and fine emery paper on twin grinding surfaces. A reserve supply of 150 ft. of abrasive paper is contained in rolls and can be quickly drawn into position for use.

7. No. 1400 Emery paper disc grinder. Four grades of abrasive paper are provided for grinding on the four sides of discs, 8" in diameter. Motor 1/3 hp. with two speeds, 575 and 1150 R.P.M.

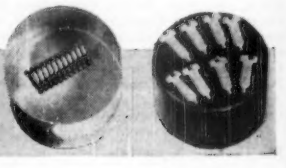
8. No. 1015 Cut-off machine for table mounting with separate unit recirculating cooling system No. 1016. Motor 1 hp. with capacity for cutting 1" stock.



THE BUEHLER LINE OF SPECIMEN PREPARATION EQUIPMENT INCLUDES . . . CUT-OFF MACHINES • SPECIMEN MOUNT PRESSES • POWER GRINDERS • EMERY PAPER GRINDERS • HAND GRINDERS • BELT SURFACERS • MECHANICAL AND ELECTRO POLISHERS • POLISHING CLOTHS • POLISHING ABRASIVES

Buehler Ltd.
A PARTNERSHIP

METALLURGICAL APPARATUS
165 WEST WACKER DRIVE, CHICAGO 1, ILL.



ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315 | R. E. Hess, Editor | R. J. Painter, Associate Editor | CABLE ADDRESS—TESTING, Philadelphia

Number 179 | JANUARY, 1952

Progress on Many Fronts in ASTM Research and Standardization Work

New Fields Covered, Important New Standards, and Many Publications Result from 1951 Operations

MANY important accomplishments can be noted as a result of the intense activity in research and standardization carried out by the Society largely through its technical committees in 1951. The Directors authorized formation of committees in several new fields, there were many important new standards —both specifications and tests completed, and new research was instituted in many fields. Taken altogether, 1951 operations constitute an impressive record of service for those in industry and government concerned with the field of materials.

Although the condensed statements of outstanding accomplishments in technical committees which follow (extensive it must be admitted, even though condensed), will be of interest particularly to those concerned with specific fields, such treatment is the only logical way of presenting an overall concept of developments. Material is arranged under appropriate headings and generally in accordance with the serial designations of the main technical groups.

In the belief that most of our members are broadly interested in developments in the Society, even though they may be particularly concerned and work with specific fields, we recommend reading the whole article.

New Fields of Work:

New activities instituted in 1951 concern the field of atmospheric sampling and analysis, cellulose and cellulose derivatives, and radioactive isotopes. New technical committees D-22, D-23, and E-10, respectively, were organized to direct this work, and each committee has held meetings and established a subcommittee structure and selected competent and interested personnel. There is tremendous interest and concern in each of these fields, and from the research and discussions, there will come an increasing output of valuable results.

Several joint committees were established to coordinate work with other societies or in ASTM itself; for example, such joint groups as those on Shipping Containers and Textile Test Methods.

Emergency Standards:

In May the Board reinstated the procedure for issuing emergency alternate provisions and standards which had been used so effectively during World War II. Essentially, this follows the earlier practice, but with added safeguards to insure a real need and also a consensus in the committees where emergency actions are recommended. Several emergency provisions have been issued carrying EA designations as covered in earlier BULLETINS. (A complete list of EA's appeared on page 15, December BULLETIN. Most are in the field of steel and stainless alloys, with two, however, concerning insulating tape.)

Technical Publications:

Attempting to single out the most important ASTM publications issued has the same condition as selecting major accomplishments in committee work—how important they are depends on one's chief interest. One could safely report that every publication was outstanding, since it would have been sponsored either by a technical committee of the Society or the Committee on Papers, and competent reviewers would have approved the contents. Perhaps the safe procedure is simply to list the titles of the special books that have come out in 1951. They have all been publicized in the BULLETIN, and members have received additional information concerning them.

STP 106 Symposium on Triaxial Testing of Soils and Bituminous Materials
STP 108 Symposium on Corrosion of Materials at Elevated Temperatures
STP 110 Symposium on the Nature, Occurrence, and Effects of Sigma Phase
STP 111 Methods of Measuring Viscosity at High Rates of Shear
STP 112 Symposium on the Rôle of Non-Destructive Testing in the Economics of Production
STP 113 Symposium on the Identifica-

Are you interested in: Summary of 1951 Progress—pp. 5-14; New Standards—p. 14; 1952 Book to be in 7 parts; New Publications—pp. 16-20; Some Unsolved Problems—p. 28; Conserving Nickel—p. 32; Fatigue Tests of Aluminum, Electron Metallography, Schnadt Toughness Test, Fundamentals of a Test Method, Ceramic Whitewares, Testing Machines—pp. 51-74.

tion and Classification of Soils
STP 15C Manual on Quality Control of Materials
STP 60A Paper and Paperboard

Meetings:

A new high in attendance was recorded at the Annual Meeting in June, with 2277 present (excluding ladies), and over 600 meetings of technical committees. The Spring Meeting and Committee Week were covered in detail in the April BULLETIN.

Numerous districts have sponsored successful technical meetings and several continued the trend of having these in cities where ASTM has not had any formal meeting previously. For example, New England had an excellent meeting in Hartford, Conn., and the Ohio Valley District arranged our first meeting in Louisville, a significant industrial center. In addition to Louisville, President Fuller spoke at the first District meeting held in Allentown, Pa., sparkplugged by the Philadelphia District. One District meeting might be singled out, namely the joint affair on November 8, 1951, in Los Angeles where F. L. LaQue, the 1951 Marburg Lecturer, spoke to an audience in excess of 500. Further details are in this BULLETIN.

New Lecture:

In collaboration with Battelle Memorial Institute, the Society established a new annual lecture, the H. W. Gillett Memorial Lecture, which will each year bring an address by some outstanding authority covering a significant topic in the field of metals, in which Dr. Gillett, former Director of Battelle and a most constructive worker in ASTM, majored. Details of the lecture were announced in the December BULLETIN, page 16, and the January BULLETIN, announces Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., as the first Gillett Memorial lecturer. It also notes that the 1952 Marburg Lecture is to be by Dr. R. C. McMaster, Battelle Memorial Institute, leading authority on the subject "Non-Destructive Testing."

Finally, we note as we have on many occasions and shall continue doing, that whether it is a successful symposium and publication, or the establishment of a new lecture, or some administrative development, or an important new standard or piece of research, the successful outcome can usually be attributed to some active ASTM member or group of members. We feel that the entire group of men (and a few women) constituting the Society can take pride in what ASTM brought forth in its 49th year of incorporation.

(*See you at the Fiftieth Anniversary Meeting the week of June 23, 1952—Hotels Statler and New Yorker, New York City.*)

Steel—Drum Forgings, Springs, Tires, Tubing, Bars

The more than 150 specifications in the province of Committee A-1 are under continuing survey so that they may be kept reasonably up to date, and represent latest thoughts and practice. However, each year seems to bring new demands for standardized requirements, and 1951 was no exception. Consequently a number of new specifications were issued, or important revisions effected, as noted below.

Reference might be made to one practice in writing specifications for families of somewhat similar products in which A-1 pioneered, namely to cover in a "master" or "envelope" specification such matters as tolerances, definitions, requirements on test specimens, speed of testing, marking, etc., that are common to various products; then in the respective product specifications covering in condensed form the particular quality requirements. This was first tried with structural steel, later with plates for boilers and pressure vessels, and it is believed the systems are working out quite satisfactorily. It is noted that in the field of non-ferrous metals and alloys Committee B-5 is completing a similar system (see later notes on copper alloys).

As a companion to the Tentative Specification A 266 for Carbon Steel Seamless Drum Forgings, a new Specification for Alloy Steel Drum Forgings for pressure vessels has been developed (A 336). Eight ferritic and six austenitic grades are covered.

The spring steel field has benefited by the addition of a new specification for nickel-chromium-molybdenum steel bars for springs (A 332). Six grades are included, three of which are specified to hardenability requirements; the latter is an important new phase in this field.

Emergency alternate provisions in Specifications A 26 and A 329 for steel tires have been issued. For tires made of acid steel the maximum permissible phosphorus content has been raised. Also the manganese range in Specification A 329 for heat-treated tires has been widened to conform to the manganese range in Specification A 26 for untreated tires. This would permit a portion of a heat manufactured for untreated tires to be used for heat-treated tires when small orders are involved.

Emergency alternates for maximum phosphorus content on ladle and check analysis have been issued for the following nine steel tubular specifications:

A 199	A 249	A 270
A 200	A 268	A 271
A 213	A 269	A 312

Other emergency alternates cover grades of austenitic steel with columbium additions and permit additions of columbium plus tantalum, affecting Specifications A 269, A 271, and A 312 of the above list.

Three grades of ferritic steel subject to impact test requirements are included in the new Specifications for Seamless and Welded Steel Tubes for Low Temperature Service (A 334). The ferritic alloy grades of seamless steel pipe in Specifications A 158, A 206, A 280, and A 315 have been consolidated in the new Tentative Specifications for Seamless Ferritic Alloy Steel Pipe for High Temperature Service (A 335), with the addition of two new grades.

The Tentative Specifications for Alloy Steel Rounds Suitable for Oil Quenching to End-Quench Hardenability Requirements have been thoroughly overhauled and under the A 304 – 51 T designation offer 24 tables of the latest hardenability data. Seven tables present approximate minimum and maximum cross-sectional as-quenched hardness values for 58 grades of alloy steel. Seventeen other tables give end-quench hardenability band limits and corresponding bar diameters for these 58 grades. The revision represents a tremendous amount of detailed work.

Cast Iron

The two developments of greatest interest in Committee A-3 during the past year have been the issuance of Tentative Specifications for Nodular Iron Castings (A 339 – 51 T), and the revision of Specification A 278 covering Gray Iron Castings for Pressure Containing Parts for Temperatures up to 650 F to bring it in accord with ASME Boiler Code requirements. The new nodular iron specification covers two grades of material, with minimum tensile strengths of 80,000 and 60,000 psi (for additional news on this item see article on New Standards in this BULLETIN).

Corrosion of Iron and Steel

Chain Link Fence Galvanized Before Weaving:

Supplementing the existing specification for chain link fence fabric, galvanized after weaving (A 177), Tentative

Specifications for Zinc-Coated Iron or Steel Chain Link Fence Fabric, Galvanized Before Weaving, was issued in 1951. The new tentative, A 337, covers four sizes of wire in two coating weight classes.

Country-Wide Wire Tests:

Bare steel, zinc-coated, copper-covered, and lead-coated steel wire, and chromium and chromium-nickel steel wires have been exposed for 14 yr in the country-wide atmospheric corrosion tests. A biennial report of Committee A-5 on these tests was published in 1951. The test site on Brunot Island in the Ohio River at Pittsburgh was discontinued in 1951 and the specimens remaining there were transferred to the roof of the Bureau of Mines Building, also in Pittsburgh. The specimens at the various sites have been exposed sufficiently long so that the data indicate definite results which might be expected from materials in similar locations. The findings on zinc-coated specimens show an expected over-all average annual loss of coating of 0.369 oz per sq ft of surface at Pittsburgh; Sandy Hook, 0.117; and State College, 0.060.

Malleable Iron

A new Tentative Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service, designation A 338 – 51 T, gives up-to-date requirements for these materials and enabled the cancellation of an older Standard, A 277.

Columbium-Tantalum in Stainless Steels

In view of the virtually nonexistent supply of ferrocolumbium, work of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys during the past year has included studies of the possible substitution of a columbium-tantalum ferro-alloy as an alternate. A special subcommittee investigated the effects of such substitution on the physical properties of the various austenitic stainless steels and as a result Committee A-10 recommended to the Society the following emergency alternate provision: "In view of the limited availability of columbium (with the heretofore usual small percentage of tantalum) the stabilizing addition to type —— shall consist of columbium plus tantalum. The ratio of columbium to tantalum (in relation to the carbon content of the steel) and the maximum of each element, or of one of them, or of the two combined, shall be determined in accordance with the requirements of the end use and shall be as mutually agreed upon by the manufacturer and the purchaser."

Wires for Electrical Conductors

The first ASTM specification in the metals field incorporating quality control features was developed by Committee B-1 during the past year; Specification B 1–51 T for Hard-Drawn Copper Wire among other features includes a sampling procedure for determining physical properties based on a statistical approach.

Committee B-1 has also arrived at a basis for rounding off the nominal diameters and cross-sectional areas of Awg sizes of wire into figures commensurate with production methods, and the Tentative Specifications for Standard Nominal Diameters and Cross-Sectional Areas of Awg Sizes of Solid Round Wires Used as Electrical Conductors (B 258) include a table giving these values. Also included are formulas and rules for the calculation of standard nominal weights and lengths, resistances, and breaking strengths of such wires.

Corrosion of Non-ferrous Metals and Alloys

Atmospheric exposure specimens of copper, bronze, brass, aluminum, nickel, lead, zinc, and tin on test since 1931 at Phoenix, Ariz.; Key West, Fla.; and other locations have been removed from the test racks and data resulting from this 20-year exposure will be included in a subsequent report of Committee B-3. The amount of corrosion will be determined in two ways; loss in weight of plate specimens and loss in strength and ductility by means of tension tests.

The Subcommittee on Galvanic and Electrolytic Corrosion which completed part 1 of its three-part magnesium exposure program last year, has now begun exposure of part 2. The specimens for part 2 consist of a threaded screw around which is wound a dissimilar metal wire. Weight loss of the wires will be determined at various intervals. Part 3 will consist of riveted plates of dissimilar metals.

Copper and Copper Alloys

In 1951 Committee B-5 completed a rearrangement of the many specifications under its jurisdiction, developing four new "envelope" specifications covering requirements common to a particular field of copper and copper alloys. The envelope specifications are as follows:

Tentative Specification for General Requirements for:
- Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar (B 248)
- Wrought Copper and Copper-Alloy Rod, Bar, and Shapes (B 249)
- Wrought Copper-Alloy Wire (B 250)
- Wrought Seamless Copper and Copper-Alloy Pipe and Tube (B 251)

As an example of this arrangement, dimensional tolerance tables, sampling procedures, methods of testing and chemical analysis, etc., for plate, sheet, strip, and rolled bar are included in B 248 and the individual product specifications include quality requirements only. For the other requirements reference is made in the individual specifications to B 248.

A complete revision of the Method of Mercurous Nitrate Test for Copper and Copper Alloys (B 154) includes a reduction in the concentration of the solution and an increase in the time of exposure.

Die-Casting Variables

As a result of intensive interest in the effect of variables in the die-casting process, Committee B-6, in 1947 formed a Subcommittee IX on Die-Casting Processes. This group was charged specifically with the investigation of certain factors pertinent to the die-casting process including pressure, temperature, plunger speed, melting practices, die gating and venting, and die lubrication. This investigation, details of the work, and conclusions drawn are covered in a significant paper by W. Babington and D. H. Kleppinger on "Aluminum Die Castings—The Effect of Process Variables on Their Properties." Among the numerous conclusions drawn is one pertinent to the optimum conditions for producing a casting of the highest quality. These conditions are: (1) measured metal pressure, 200,000 psi; (2)

1902
FIFTIETH ANNIVERSARY MEETING
TENTH EXHIBIT OF TESTING APPARATUS AND LABORATORY SUPPLIES • Photographic Exhibit
June 23-27, 1952 • Hotels Statler and New Yorker • New York City
1952

gate velocity of metal, 1090 ft per sec; (3) thin gate (approximately 0.030 in.); (4) high plunger speed (approximately 375 ft per min); and (5) adequate die venting.

Aluminum and Magnesium Exposure Tests

More than four years of work by Committee B-7 including planning a program, selecting test sites, procuring specimens, and handling many other details has now culminated in the exposure of a series of aluminum and magnesium specimens at five locations. Outdoor exposure of these specimens has begun at State College and New York City, and it is expected that the exposure at the other three locations will be completed early in 1952. There are 1600 specimens at each location consisting of sheet, sand-cast, and permanent-mold tension bars, spot-, gas-, and arc-welded specimens, and riveted specimens. Thicknesses vary from 0.063 to 0.25 in.

Electrodeposited Coatings

New Recommended Practices:

In 1951 Committee B-8 on Electrodeposited Metallic Coatings added to its growing list of recommended practices for preparation and plating on various materials, three new tentative recommended practices. These cover:

1. Preparation of Zinc Base Die Castings for Plating (B 252).
2. Preparation of and Plating on Aluminum Alloys (B 253).
3. Preparation of and Plating on Stainless Steel (B 254).

A recommended practice for plating on copper is in draft form and work has begun on recommended practices for preparation of lead and lead alloys for plating, preparation of gray and malleable iron for plating, and preparation of and plating on plastics.

Performance Tests:

Subcommittee II on Performance Tests issued another interim report on the results of exposure tests begun in 1947. These specimens were approximately copper-nickel-chromium platings on high-carbon steel, the variables being the thickness of copper, pH of the nickel bath, and bright *versus* dull nickel. The present conclusions indicate:

1. The type of atmosphere has a great effect on the rate of their deterioration.
2. The thickness of nickel plate is the determining factor in such coatings.
3. Copper undercoatings add little to the protective value of composition coatings.
4. Buffing of a copper undercoat has a slight beneficial effect, if any.
5. Applying a nickel coating in two steps with the first layer buffed is highly beneficial in a coastal environment but of no benefit in industrial atmospheres.
6. Types of nickel plate (dull or bright) exert no important influence on coating life.
7. Identical coating systems behave similarly on different steel bases.

Metal Powders and Metal Powder Products

During the year Committee B-9 approved designs for an unmachined and a machined tension test bar for metal powder products and transmitted these to Committee E-1 for consideration and ultimate issuance as ASTM standards.

Also issued was a new Specification for Sintered Structural Parts from Bronze (B 255). The existing specifications B 222 covered only one iron-copper composition and a definite need developed for the new B 255.

Cement

Committee C-1 on Cement contributed liberally to the store of information on the interesting method of chemical analysis using the flame photometer apparatus, through joint sponsorship with Committee D-2 on Petroleum Products and Lubricants of a Symposium on Flame Photometry, now being published. A new tentative method was adopted for determining the presence or absence of calcium sulfate in hardened portland cement mortar. Much has been accomplished in securing a background of data upon which to base specification requirements for fly ash, portland-fly ash cement, and blended cement containing calcined reactive siliceous materials.

Magnesium Oxychloride and Oxysulfate Cements

A test method for determining the shear strength of bonding media for magnesium oxychloride cements has been developed by committee C-2 to complete a series already adopted by the Society. The first specifications for materials in this field have now been accepted by the Society. These set up requirements for oxychloride magnesia (C 275 T), magnesium chloride (C 276 T), and magnesium sulfate Epsom salts, technical grade (C 277 T).

Chemical Resistant Mortars

A valuable and long-needed test procedure for determining the resistance of hydraulic-cement mortars to chemical attack (C 267 T) has become an ASTM tentative through the efforts of Committee C-3. It measures the effect on properties such as weight, strength, and appearance of specimens, after exposure to a reagent. This is the initial contribution of the recently formed committee in this field.

Clay Pipe

A recommended practice of many years standing was completely rewritten and brought up to date by Committee C-4, this is the recommended practice for laying sewer pipe (C 12 T), which will now apply only to clay pipe. An additional type of clay pipe, namely, extra strength ceramic glazed clay pipe, now is covered by an ASTM specification (C 278 T).

Refractories

Castable refractories are now covered in two test methods developed by Committee C-8 on Refractories. These determine modulus of rupture (C 268 T) and reheat change (C 269 T). A revision of the widely distributed C-8 Manual on Refractory Materials has been a notable accomplishment. This much-used book now being published will contain the latest standards and industrial surveys covering fields not heretofore included, these being malleable iron, lead, and incinerator furnaces.

Concrete and Concrete Aggregates

Three new subcommittees of C-9 on Concrete and Concrete Aggregate have become active during the past year on important subjects in this field. A long-awaited standard freezing-and-thawing test procedure may now be possible through the efforts of one of the new subcommittees charged with this objective. The abrasion of concrete and setting time are other properties which now have organized programs of study under way.

The research group of subcommittees have developed several test methods for measuring the effects of chemical reactions between aggregate and cement. A comprehensive description of constituents of natural mineral aggregates was published as information and is now expected to be recommended as tentative.

A comprehensive revision of the Specifications for Concrete Aggregates (C 33) has been studied involving the inclusion of specific limits rather than requiring these limits to be stated in terms of meeting local conditions.

Masonry Mortar

Discussions by Committee C-12 covering a period of twelve years culminated in the acceptance of tentative specifications for mortar for unit masonry (C 270 T). Five types of mortar are covered in each of two alternative specifications, one based on acceptability of

mortars by the properties of its ingredients and the resulting mortar, and the other on the properties of the ingredients and of their proportions.

Concrete Pipe

Specifications on concrete pipe, developed by Committee C-13 on Concrete Pipe, are universally accepted and used throughout the construction industry. The experiences in the use of these specifications for the past ten years have resulted in a series of minor revisions accepted this past year. A broader aspect has been approached in the formation of a long-range planning group to study major revisions and improvements such as the possible use of cores for testing compressive strength, correlation of steel sizes and test loads in relation to the required steel, and possible revision of the ratio between the 0.01 crack and ultimate failure.

Thermal Insulating Materials

The first of a series of specifications by Committee C-16 was accepted by the Society covering three types of industrial insulation material (C 195 T, C 196 T, C 197 T). These specify composition, dimensions, and physical properties of mineral wool felt, batt insulation, and blanket (metal-mesh covered) insulation.

A symposium sponsored by the committee at the 1951 Spring Meeting and soon to be published presented much information and data on certain properties of thermal insulation in addition to that of conductivity, such as water vapor migration, surface emittance, and specific heat.

Structural Sandwich Constructions

During the year, Committee C-19 prepared tentative test methods for density, water absorption, dimensional stability, thermal expansion, and bondability of basic materials used in structural sandwiches and for shear flatwise and compressive properties of the basic sandwich construction. Of these, the methods for compressive properties, water absorption (C 272 T), density (C 271 T), and the shear test (C 273 T) have been approved.

A symposium sponsored by the committee provided information on the magnitude and variety of combination of materials used in this new type of construction and the research and testing which have gone into their development. This is now being made available as a special publication.

Acoustical Materials

The five fields of investigation being conducted by Committee C-20 and the problems involved were discussed in a symposium which will be published. The measurement of sound absorption, although the basic problem, is also accompanied by the problems of combustibility, maintenance, application, and other basic physical properties, all of which enter into the successful performance of acoustical materials.

Porcelain Enamel

The first methods of test in the porcelain enamel field were accepted upon recommendation of Committee C-22. Resistance to boiling acid (C 283 T) and to impact (C 284 T) of porcelain enameled utensils are described in two separate methods, with two additional methods for sieve analysis of wet milled and dry milled porcelain enamel (C 285 T) and for acid resistance of porcelain enamels (room temperature) (C 282 T). A series of definitions of terms relating to porcelain enamel (C 286 T) were also approved.

Paints and Related Materials—Exposure Tests, Drying Oils, etc.

The numerous accomplishments of Committee D-1 included several cooperative activities. One in collaboration with the Federation of Paint and Varnish Production Clubs was the issuance of record forms for exposure tests of paints (D 1150). The single and multiple panel sheets that have been developed (available in pad form), give convenient methods for recording exposure data from paint panels.

With thousands of exposure tests being made, it is important that there be some rational method followed, and hence the extensive revisions made in the recommended practice for conducting exterior tests on woods are important. This standard (D 1006) embodies principles considered necessary for reliable results. The appendix describes the construction of a test fence, test panels, and gives related information.

Extensive revisions of the Methods for Testing Drying Oils (D 555) were completed. They were, in a sense, a consolidation and modernization of certain older methods, but include new tests as well. In this work, there was cooperation with the American Oil Chemists Society.

In this BULLETIN, in an article on New Standards, are announcements of very recent developments, namely the new Specification for Asphalt Base Emulsions for Use on Metals (D 1187), and a Test for Measuring the Dry Film Thickness of Non-Magnetic Coatings (D 1186).

This year Committee D-1 will commemorate a half century of organization as a technical committee. During this period, the extensive research work and the standardization activities of this group in which many of America's leading technologists have and continue to participate, have been of incalculable benefit to all those concerned with paint, varnish, lacquer, and related materials. The committee plans to have appropriate observance of its 50th anniversary during the ASTM Annual Meeting in New York, the week of June 23, 1952.

Needed: Copies of Part 1—Ferrous Metals, 1949 Book of Standards

IT IS quite apparent that before many weeks the stock of Part 1—Ferrous Metals, 1949 Book of Standards, will be in a very low state. Present available copies of the book are such that we can continue to meet the demand for it through February, at least, but there is no slackening in the orders for the book and, of course, many of the new members request this part on their membership. So that we can fill urgent orders for Part 1 after the current supply is exhausted, a plea is being made to members and other purchasers, who may not have constant need for the book to sell their copy to the Society. We will buy back copies of 1949, Part 1, at $4 each, it being assumed the book would be in reasonable condition for resale.

Members and purchasers may be able to meet their needs through other copies in their organizations, through some one of the special compilations that have been issued (pipe and tubing, plates, structural, bars, etc.), or through the 1950 and 1951 Supplements to Part 1 which contain all of the 1950–51 standards in their latest form.

Those who are willing to dispose of any copies of Part 1, 1949 Book of Standards, may send these books to ASTM Headquarters. Be sure a return address is on the package to enable identification, and better still, also advise that shipment is being made. If the check should be made payable to any special account or name, this should be stated clearly.

(There is an ample supply of Supplements to Part 1—hence, there is no need to buy back any of these.)

Petroleum Products and Lubricants

With well over 700 members serving on its main committee and a host of sections, technical committees, research divisions, and subcommittees, ASTM Committee D-2 on Petroleum Products and Lubricants is constantly reporting significant accomplishments in its wide range of work. The latest Compilation of Standards on Petroleum Products and Lubricants, issued in September, covers some 800 pages, and as usual, includes not only the majority of the D-2 sponsored methods (excluding those on measurement and sampling, and so-called "knock testing" methods), but also other pertinent information, including the 1951 report and several proposed methods. Many of the standards are new, and a considerable number have been revised.

Engine Test Manual: Oil Measurement Tables:

Although publication of a complete new edition of the ASTM Manual of Engine Test Methods for Rating Fuels will not be accomplished until about February, 1952, major work in preparing this was completed before the New Year. The first edition of the book and its accompanying supplements were widely distributed, indicating the value ascribed to the publication by those who are concerned with evaluating fuels.

Another significant publication nearing completion will include extensive Oil Measurement Tables. Since 1946, in cooperation with the British Institute of Petroleum, intensive studies have been progressing, and the final publication will form a long-awaited basis for standardized calculations of measured quantities of petroleum.

New and Revised Specifications and Tests:

One of the early standards developed by Committee D-2, and now carrying the lowest serial designation D 56, concerns the Method of Test for Flash Point by Means of the Tag Closed Tester. This method was extensively revised and brought up to date during the year. Also D 524—Method of Test for Carbon Residue of Petroleum Products, an important method, was revised.

Among the new tests issued through Committee D-2 during the year were those covering the Test for Total Inhibitor Content of Butadiene (D 1157); two tests for Bromine Number of Petroleum Distillates—Color-Indicator Method (D 1158) and Electrometric Method (D 1159); and Test for Reduced Pressure Distillation of Petroleum (D 1160).

Revisions were completed in the specifications for Aviation Gasolines (D 910); these requirements being used by purchasing agencies in formulating specifications. Among the changes were the addition of new grades of gasoline.

Additional methods in which important changes were incorporated cover Aniline Points and Mixed Aniline Points (D 611), Chlorine in Oils and Greases (D 808), Aromatic Hydrocarbons in Olefin-Free Gasolines by Silica Gel Adsorption (D 936), Evaporation Loss of Greases and Oils (D 972), Determination of Purity from Freezing Points (D 1016), and Distillation of Plant Spray Oils (D 447).

An extensive statement on work under way by Committee D-2 appeared in the October, 1951, ASTM BULLETIN, beginning on page 21.

Road and Paving Materials

Additional test methods and specifications on bituminous paving mixtures were completed by Committee D-4. These include tests for specific gravity of compressed bituminous mixtures (D 1188 T) and for resistance to plastic flow of fine aggregate bituminous mixtures (D 1138 T), plus specifications for crushed stone, crushed slag and gravel for single bituminous surface treatment (D 1139 T). Being recommended for acceptance is an important new tentative method for determining residue of a specified penetration involving distillation under vacuum. A proposed method of test for distillation of coal tar, coal-tar pitch, and similar tars and pitches has been published as information.

Paper

Providing a wealth of information about paper and paperboard, as well as the significance of the many tests used, a revised and expanded issue of the Monograph on Paper and Paperboard was completed by Committee D-6. Four new tentative methods of test were added to an already impressive list of ASTM standards on paper and paperboard. These methods determine the chloride content of paper and paper products (D 1161 T), water-soluble matter in paper (D 1162 T), lint of paper towels (D 1163 T), and the ring crush test of paperboard (D 1164 T).

Wood

A number of changes in botanical and common tree names over a period of years led Committee D-7 to revise and augment its nomenclature of standard names for structural timber as found in the standard D 9. It now contains an extensive list of both hardwoods and softwoods.

Electrical Insulating Materials—Waxes, Oils, Mica

Continuing interest in microcrystalline waxes as well as mineral waxes generally, led Committee D-9 to prepare a compendium of tests which may be applied to these materials. In general the committee, because of its earlier work, was able to incorporate references to other standardized tests. These new methods have a designation D 1168.

Revised methods of measuring mica stampings used in electronic devices and incandescent lamps (D 652) were completed.

The committee sponsored the fourth in a series of symposiums on electrical insulating oils at its November meeting in Niagara Falls. The three technical papers which have to do with service life and related characteristics of the oils will be issued during 1952.

Other developments announced at the Fall meetings are detailed in an article in this BULLETIN (see page 36).

Shipping Containers

The acceptance of tentative methods of tests for pallets represents the first standard of Committee D-10 in this field. Its expanded scope now includes packages and pallets. The pallet tests include static load capacity, shock load capacity, drop, incline-impact, and vibration. A further step in the direction of joint coordination with other organizations was effected during the year by the organization of the joint ASTM-TAPPI Committee on Shipping Containers, with Earl R. Stivers as Chairman.

Rubber and Rubber-like Materials—Gasket Materials, Vulcanized Rubber, Automotive Compounds, Tape

Among the significant accomplishments of Committee D-11 during the past year were new specifications and

WHEREVER THERE IS BUSINESS THERE IS SCRAP!

Dormant scrap is found wherever obsolescence, wear, accident, damage, or other cause has brought retirement from active service of products containing steel, iron, copper, brass, bronze, aluminum, lead, and zinc. Now is the time t et up an aggressive program for searching it out and turning it in! The nation's defense effort needs this scrap.

tests relating to gasket materials, vulcanized rubber, automotive compounds, and tape—the latter involving emergency alternate provisions.

Much could be written about the new specifications for nonmetallic gasket materials for general automotive and aeronautical purposes (D 1170). Developed in the joint SAE-ASTM technical committee of D-11 they cover materials that are composed of natural or synthetic rubbers, cork, papers, asbestos, and various combinations. This significant new specification has resulted from intensive work over at least two years; embodied in it is a great wealth of data. In fact when we see the three-page and a half, six-point type tables covering identification numbering systems and details of the various types of gaskets, one can realize the great amount of time and effort embodied in developing and agreeing on the data that is given.

The new test (D 1147) for compressibility and recovery of gasket materials is essentially a short-time test applicable to sheet-gasket materials.

The test for discoloration of vulcanized rubber - organic finish coated or light colored (D 1148) sets up standard conditions for producing and evaluating changes in color which may result from exposure to heat and sunlight.

The new method for accelerated ozone cracking of vulcanized rubber (D 1149) gives an estimate of the relative resistance to cracking when the material is exposed, under tension, to air with low ozone.

The ability of rubber or synthetic compounds used for automotive parts to withstand weathering is very important in many applications and a standard test for determining this is provided in new method D 1171.

On May 26 emergency alternate provisions were issued in the specifications for friction tape (D 69) and rubber insulating tape (D 119). The reduced allocation of crude rubber justified these provisions which in the case of D 69 omits the adhesion test after oven aging and increased slightly the number of permissible pinholes. In D 119 the requirement for natural rubber was eliminated and properties were somewhat modified. These emergency alternate provisions were published in the September ASTM BULLETIN, page 28, and "pink slips" giving the EA's are available.

Soaps and Other Detergents

In Committee D-12 some improvements were incorporated in two 1950 significant specifications covering soaps for low-temperature washing, namely chip or granular soap (D 1111), and solid soap (D 1112). These materials are primarily for use with wool fabrics, finished surfaces, leather, and such materials where low-temperature solutions are indicated. Two new tests were also completed covering the pH of Aqueous Solutions of Soaps and Detergents (D 1172), and the Foaming Properties of Surface-Active Agents (D 1173).

A publication is nearing completion, comprising several technical papers and various wetting test methods presented at the March meetings of Committee D-12. Those concerned with this field will find the publication of much interest.

Just submitted for editing, and eventually publication, is a very extensive supplement and revision of the Bibliography on Metal Cleaning, which will be issued during the year. Further mention will be made of this extensive bibliography and abstracts.

The development of standard methods for analysis of synthetic detergents has presented a difficult problem to the committee. Subcommittee T-2 on Analysis of Synthetic Detergents has been reactivated and plans to undertake the following projects in the order listed:

(*a*) Development of an annotated bibliography of the analytical methods.
(*b*) Development of specific methods for widely used industrial synthetics.
(*c*) Development of a scheme for identification or analysis of synthetics.

Textile Materials

For many years there has been intensive interest in the ability of various textile fabrics to withstand abrasion and wear but with all of the complications and problems involved standardization has been difficult; however, Committee D-13, culminating years of study and much discussion, did agree during the year on tentative methods for resistance to abrasion of textile fabrics (D 1175). Five types of testing methods are covered by the committee in its attempt to reach greater standardization, lessen the confusion, and clarify some of the problems. Perhaps it is appropriate to include the Introduction to these methods which indicates some of the problems....

"The measurement of the resistance to abrasion of textile and other materials is very complex. The resistance to abrasion of textile materials is affected by many factors, such as the inherent mechanical properties of the fibers, the dimensions of the fibers, the structure of the yarns, the texture of the fabrics, and the type, kind, and amount of finishing material added to the fibers, yarns, or fabrics. The resistance to abrasion is also greatly affected by the conditions of the tests, such as nature of abradant, variable action of the abradant over the area of specimen abraded, and the variations during a test of: the abradant, the tension on the specimen, the pressure between the specimen and abradant, and the dimensional changes in the specimen.

"The measurement of the resistance to abrasion may also be affected by the method of evaluation of the amount of abrasion and may be influenced by the judgment of the operator...."

To other than textile technologists the title of the test for apparent fluidity of dispersions of cellulose fibers (D 539) might not be too significant but a sentence in the scope clause indicates why this test is so important. . . . "The result is a sensitive measure of the degradation of the cellulose resulting from the action of light, acids, alkalies, oxidizing agents, reducing agents, and the like in processing, laundering, and use." Revisions effected in 1951 provide three different methods of conducting the test.

Committee D-13 has taken a leading part in international activities and at the meeting of ISO Committee 38 on Textiles in England in June most of the American delegation included men active in or in touch with the work of Committee D-13. The American group now serving on this committee is sponsored jointly by ASTM and the American Association of Textile Chemists and Colorists which provides for direct representation from American industry.

Adhesives

In addition to strength properties, the permanency and working qualities of adhesives received considerable attention by Committee D-14. Two recommended practices were accepted dealing with strength development of adhesive bonds (D 1144 T) and the effect of moisture and temperature on adhesive bonds (D 1151 T). Two other new methods determine the blocking point of potentially adhesive layers (D 1146 T) and the effect of bacterial contamination on the permanence of adhesive preparations and adhesive bonds (D 1174 T). A third new method measures the resistance of adhesives for wood to cyclic accelerated service conditions (D 1183 T). An additional strength test method accepted is a flexural loading test (D 1184 T).

Engine Antifreezes

Added to the six standards developed through the work of Committee D-15 were two important 1951 new tentatives covering freezing point, D 1177. and procedures for sampling and preparing aqueous solutions, D 1176. The freezing point test is designed for the laboratory and involves the determi-

nation of the time-temperature curve prior to freezing and of the flattened portion of the freezing curve. The actual freezing point is taken as the intersection of the projections of the cooling and freezing curves. Methods D 1176 are intended primarily to aid in insuring reproducible results in laboratory methods. The method covers taking a representative sample from the original container and other procedures.

These two methods, together with the others issued previously by Committee D-15, are being published in a special compilation of some 40 pages, soon off press. There has been widespread interest in the proper use and evaluation of engine antifreezes and this compilation should be very helpful in providing authoritative standards.

Naval Stores

One of the activities under way in Committee D-17 is the development of specifications, a new subcommittee on this subject having been authorized in 1950. The committee has issued a number of tests and sets of definitions. Numerous revisions were approved in the standard terms D 804 brought about by new nomenclature in Federal work and the use of tall oil as a source of rosin acids.

Several tentatives for evaluating tall oil and ash and iron in rosin were adopted as standard and three other tentatives, after revisions, also were adopted as standard, these methods covering acid number of rosin D 465, saponification number D 464, and water in naval stores D 890.

Soils

Continuing its activity in research on soils for engineering purposes Committee D-18 sponsored two symposiums dealing with consolidation testing of soils and surface and subsurface reconnaissance. The papers presented as part of the two symposiums have been described previously in the BULLETIN, the July and September issues. The special publications will be available shortly.

Industrial Water

Among the several items of "standardization" interest in Committee D-19 was the revision and reversion to tentative of the Method for Sampling Boiler Water from Stationary Boilers (D 860), new Specifications for Equipment for Sampling Industrial Water and Steam (D 1192) were issued, and there were two new tests covering Chloroform-Extractable Matter in Industrial Water (D 1178), and Fluoride Ion in Industrial Water (D 1179).

Plastics

Committee D-20 added to its rather considerable number of important specifications and test methods, three new standardized procedures for which there has been a demand. The test for bursting strength of round tubing, D 1180, measures the resistance offered by this material to rupture by internal pressure. Since distortion of sheet plastic specimens is important in many applications, a new test for warpage, D 1181, is of considerable interest. This is intended to cover distortion resulting from exposure to service conditions. Another new method, D 1182, relates to the apparent density and bulk factor of granular molding factors.

Several additions were made to the standard definitions of terms D 883, notably in relation to adhesives.

A great deal of work is under way, both of a research and standardization nature, in the D-20 subcommittees, and some further information on this is given in the account of the November meeting appearing elsewhere in this BULLETIN.

Air Analysis

October 1 and 2 marked the effective beginning of the Society's work in atmospheric sampling and analysis as this was the initial meeting of Committee D-22 on Methods of Atmospheric Sampling and Analysis. Four subcommittees have been set up as follows:

Subcommittee I on Nomenclature and Units, whose duty will be to develop definitions, abbreviations, etc., for particulate matter and gases.

Subcommittee II on Methods of Sampling will include general methods, sampling of gases, vapors, and particulate matter, sampling for particle size and stack rating.

Subcommittee III on Analytical Methods designated task groups to work on fluorides, sulfur compounds, nitric oxide, particulate matter, aldehydes, and odors.

Subcommittee IV on Instrumentation will include in its early work a study of filtration, impingement, and optical methods for determination of aerosols and the study of modifications in the sulfur dioxide recorder for determination of gases.

The first work of all task groups will be a literature search to evaluate present methods of analysis. This will be followed by study, and research if necessary, to provide necessary information to warrant their publication as ASTM standards.

Methods of Testing—Absolute Viscosity, Softening Point, Tension Testing Metals

A significant and very informative report on the principles involved in determining absolute viscosity was issued through the work of a Committee E-1 task group, under the editorial direction of W. H. Markwood, Jr. This report gives a simplified discussion of principles in determining viscosity in absolute. One purpose of the report is to encourage the recognition and use of instruments yielding results in standardized units. Considerable effort went into this report and one of the many valuable sections is a list of some 74 references to significant publications on the subject, together with a list of American manufacturers of viscometers. The revised tentative test for softening point by ring and ball apparatus, E 28, represented a consolidation of two previous methods. A series of round-robin tests is intended to evaluate this method.

The revised Methods of Tension Testing of Metallic Materials, E 8 provide added procedures for steel spring wire and copper rods and bars.

Emission Spectroscopy

Committee E-2 has had the problem of compiling and studying various methods of analysis used throughout industry in order that it could reach some agreement on standardized procedures. Partly in an effort to focus attention on the more desirable features of certain methods and to pave the way for standardization, the committee has asked ASTM to publish, in a special booklet, some 50 suggested methods. Editorial work has been under way on these methods and it is hoped the some 200-page compilation will be available by early Spring.

Metallography—Grain Size, Thermal Analysis

Pursuing its policy of establishing grain size standards for fields of metals where needed, Committee E-4 developed in 1951 the Methods for Estimating the Average Grain Size of Non-Ferrous Metals, Other Than Copper, and Their Alloys (E 91). Grain size charts for both twinned and untwinned grains are included in these methods. The Society now has published charts for ferritic (E 89) and austenitic (E 19) steel grain size, for wrought copper and copper alloys (E 79) and for other nonferrous metals (E 91).

The Recommended Practice for Thermal Analysis of Steel (E 14 – 33) has long needed a thorough overhauling. In 1951 this was accomplished and at the same time the recommended practice was expanded to cover all metals and alloys.

Non-Destructive Testing

Committee E-7 has been very active in several fields which should be mentioned. The Subcommittee on Ultrasonic Testing has arrived at a basis for

writing test methods in this field and is well along in this work. In this respect, not only test methods but calibration blocks are being developed, as well as a glossary of terms.

In 1948 the Tentative Methods of Radiographic Testing of Metal Castings (E 15 – 39 T) were termed obsolete and withdrawn. Since then the Subcommittee on Recommended Radiographic Practice has been actively engaged in developing a document to take the place of E 15. This Proposed Tentative Recommended Practice is now in its final stages and is expected to be issued by the Society in 1952.

Fatigue

Large Machines and Test Correlation:

Further expanding the scope of its activities, Committee E-9 on Fatigue set up a Subcommittee on Large Machines and Test Correlation under the chairmanship of J. M. Lessells, Massachusetts Institute of Technology. The immediate objectives include: (*a*) preparation of summary of previous work on size effect, (*b*) exploration of testing equipment now in custody of the Bureau of Ships, (*c*) development of a test program, and (*d*) plans for fund raising.

Articles on Fatigue:

In view of the interest in the fatigue field of a number of workers, Committee E-9 has prepared a list of references to articles published in 1950 dealing with fatigue. Brief abstracts were included when readily available. If there is sufficient interest in a list such as this, additional lists may be provided periodically, for example, every six months.

Radioactive Isotopes

Because of the interest shown in the industrial applications of radioactive isotopes, Committee E-10 was organized in 1951 under the temporary chairmanship of G. G. Manov of the Atomic Energy Commission.

The scope of the new committee is as follows:

(*a*) To promote the knowledge of the use of radioactive isotopes in materials testing; (*b*) to aid and advise the technical committees of the Society in the preparation of methods and development of instruments of testing in the field of radioactive isotopes; (*c*) to prepare methods of testing using radioactive isotopes not coming within the scope of any other technical committee; (*d*) to standardize the nomenclature and definitions used in or relating to testing methods or instruments using radioactive isotopes in cooperation with other committees; (*e*) to perform such other functions as may advance, improve, standardize, and unify the procedures of materials testing by means of radioactive isotopes.

Various projects have been outlined for committee work including nomenclature, safety, standards of measurement of radioactivity, survey of ASTM methods, industrial instrumentation, natural occurring radiation, bibliography, and education and dissemination of information.

Quality Control of Materials

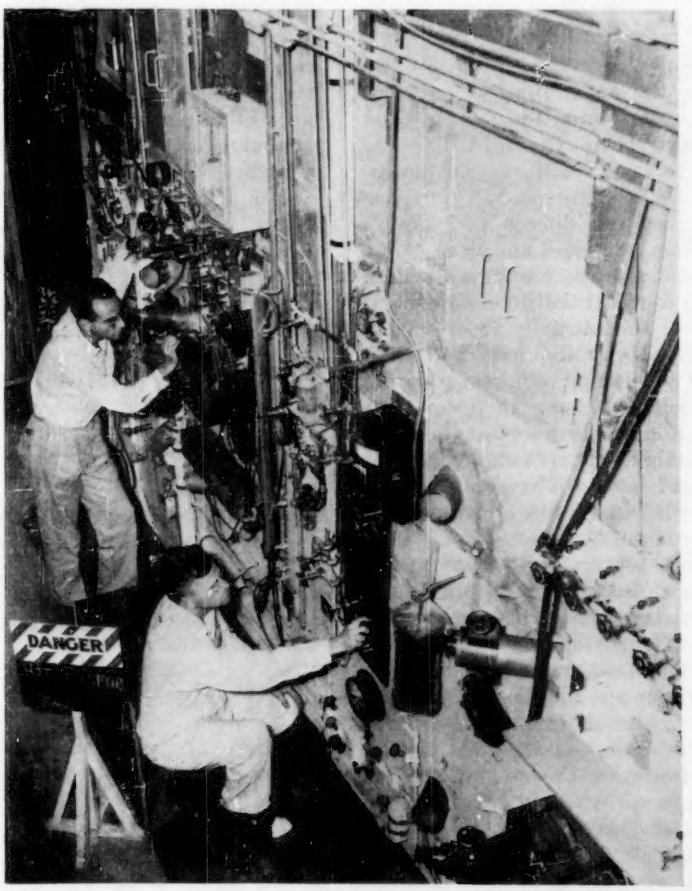
Committee E-11 completed a publication of widespread interest and far-reaching significance, namely, the ASTM Manual on Quality Control of Materials. It had been at work revising and perfecting this publication for many months, and the interest in it is shown by the fact that it is probably as widely distributed a special publication as any ASTM book. The publication has been described in the ASTM BULLETIN and in literature which has gone to the members and many others concerned with materials. It continues to be in big demand and the committee can take pride in this publication. In the preface the committee points out the basic considerations in its Manual, namely, "the quality control methods considered herein are those methods that have been developed on a statistical basis to control the quality of product through the proper relation of specification, production, and inspection as parts of a continuing process."

Another important subject being studied in the committee is the matter of bulk sampling, and publication of the several significant papers in the symposium on this subject which was held at the 1951 ASTM Annual Meeting is imminent. Comprising seven papers, the symposium will total some 70 pages. Further announcements concerning this will be made. It should be available in January, 1951.

Effect of Temperature on the Properties of Metals

The Joint ASTM-ASME Committee continued its sponsorship of technical sessions where latest information and data on the properties and tests of materials at elevated temperatures are presented. At the ASTM Annual Meeting there were some nine papers involving temperature effects. Condensed synopses of these appeared in the July BULLETIN, and all will be published in the 1951 *Proceedings*, to be available in the Spring.

At the ASME Annual Meeting there were seven technical papers including one that aroused much interest, namely



Producing radioactive isotopes is a complicated business as this picture from Oak Ridge demonstrates.

"A Time-Temperature Relationship for Rupture and Creep Stresses" which postulated the theory of using short-time tests in determining long-time properties. These papers will be published by ASME.

The committee organized a new "Panel on Test Methods" which is charged with coordinating the work in this field, including a review of the three existing methods for short-time and long-time creep tests and the rupture tests (ASTM Designations E 21, E 22, and E 85, respectively).

In November the former Subgroup on Low Temperature was formalized as a panel, in view of the steadily growing interest.

The financial campaign to raise some $85,000 to underwrite important research got under way, and the committee reports satisfactory progress toward its goal. In connection with this an interesting eight-page brochure was issued which gave some idea of the notable contributions of the committee since its organization in 1924.

The committee has arranged for an extensive symposium to be presented at the ASTM 1952 Annual Meeting in June in New York, dealing with "Effects of Notches and Metallurgical Changes on Strength and Ductility of Metals at Elevated Temperatures." It is probable that three sessions will be devoted to the 15 or more papers sponsored by the Joint Committee. These are being scheduled for Monday, June 23.

New and Revised ASTM Standards for Nodular Iron Castings, Magnesium-Base Alloy Products, Mineral Wool Pipe Insulation, Drying Oils, Protective Coatings, Electrical Insulating Materials

By action of its Administrative Committee on Standards, at meetings held in November and December of 1951, the Society approved several new specifications and revisions. These new and revised standards will appear in the appropriate 1951 Supplements to the 1949 Book of ASTM Standards, all of which are already available or should be shortly.

Nodular Iron Castings Specifications:

Developed over a period of two years by the Subcommittee on Nodular Iron of Committee A-3 on Cast Iron, these specifications (A 339 – 51 T) aim to satisfy a demand from industry for an acceptable purchase specification for ductile or nodular iron. This iron, also known as spheroidal, is defined as cast iron with the graphite substantially in spherical shape and substantially free of flake graphite. Many inquiries had been received concerning requirements, and it was felt necessary to accomplish some standardization so that the number of methods for ordering would not get out of hand. For some time a "Cinderella" metal but now an established product, nodular iron is being purchased for various applications including those where other materials, such as malleable iron, may be in short supply. Hence there was some thought in the committee of issuance as emergency specifications, especially since commercial knowledge is not fully developed. In submitting the present tentative the committee emphasizes the provisional nature of the specifications at this stage, noting that this is the first approach to coverage of this product by standardization. It is the intent of the specifications "to subordinate chemical composition to physical properties; however, the quantities of any chemical elements in the iron may be specified by agreement between the manufacturer and the purchaser." Two grades of material are covered: 80–60–03 and 60–45–10, these figures representing respectively the tensile strength, yield strength, and minimum elongation in 2 in.

Magnesium-Base Alloy Products:

Revisions in specifications covering sand castings (B 80 – 49 T) and sheet (B 90 – 49 T) bring the temper designations into agreement with current commercial practice, and in the former a change in the composition of AZ91C accomplishes the same purpose. Approved changes in Specifications for Magnesium-Base Alloy Permanent Mold Castings (B 199 – 49 T) add the Temper T6 for Alloy AM100A, and provide for insertion of temper designations to effect conformity with current commercial practice.

Mineral Wool Pipe Insulation:

The new specification developed by Committee C-16 on Thermal Insulating Materials, covers the composition, sizes, dimensions, and physical properties of mineral wool pipe insulation at elevated temperatures (C 280 – 51 T).

Drying Oils, Protective Coatings:

Tentative Methods of Testing Drying Oils (D 555 – 51 T) have been designed to meet the need of the paint and drying oil industries for a comprehensive set of methods for the purpose implied. They replace previous

Actions by ASTM Administrative Standards, November and December, 1951

New Tentatives

Specifications for:

Nodular Iron Castings (A 339 – 51 T)

Mineral Wool Pipe Insulation; Blanket-Type (C 280 – 51 T)

Asphalt Base Emulsions for Use as Protective Coatings for Metal (D 1187 – 51 T)

Method of:

Testing Drying Oils (D 555 – 51 T)

Measurement of Dry Film Thickness of Non-Magnetic Coatings of Paint, Varnish, Lacquer and Related Products Applied on a Magnetic Base (D 1186 – 51 T)

Revision of Tentatives

Specifications for:

Magnesium-Base Alloy Sand Castings (B 80 – 49 T)

Magnesium-Base Alloy Sheet (B 90 – 49 T)

Magnesium-Base Alloy Permanent Mold Castings (B 199 – 49 T)

Method of:

Testing Varnished Cloths and Varnished Cloth Tapes Used in Electrical Insulation (D 295 – 51 T)

Withdrawals

Standard Method of:

Testing Drying Oils (D 555 – 47)

Tentative Methods of:

Testing Drying Oils (D 555 – 50 T)

Test for Heat Bodying Rate of Drying Oils (D 967 – 48 T)

ASTM Methods D 555 – 47 T, D 555 – 50 T, and D 967 – 48 T, and include pertinent sections drawn from other related ASTM methods.

The new Method for Measurement of Dry Film Thickness of Non-Magnetic Coatings of Paint, Varnish, Lacquer, and Related Products Applied on a Magnetic Base (D 1186 – 51 T) (Magnetic Gage Method) supplements the Tentative Method of Test for Measurement of Dry Film Thickness of Paint, Varnish, Lacquer, and Related Products (D 1005 – 49 T). It is also recommended for thin films, less than 0.5 mil (0.0005 in.) in thickness. It does not apply to excessively soft films.

Tentative Specification for Asphalt Base Emulsions for Use as Protective Coatings for Metal (D 1187 – 51 T) is largely a performance type specification, but does include some general requirements on composition of the material. This material has been in general use for about twenty years and there has been a need for specifications. Methods of tests for these materials were completed in 1949 and were issued under the designation, D 1010 – 49 T.

Electrical Insulating Materials:

Recent revision of Method of Testing Varnished Cloths and Varnished Cloth Tapes Used in Electrical Insulation (D 295 – 51 T) clarifies certain references to Methods of Test for Electrical Resistance of Insulating Materials (D 257 – 49 T), the latter method previously having been used for testing varnished cloths and tapes, but following extensive revision in 1949 not directly applicable to these materials. Consequently the committee (D-9 on Electrical Insulating Materials) found it necessary to include in some detail in D 295 the test for insulation resistance, still using, however, as a basis the current Method D 257.

1952 Book of Standards to be Issued in Seven Parts

Revised Charges and Selling Prices Established

AFTER careful study of the problem of publishing the 1952 edition of the Book of Standards presented by the steadily growing number of standards now nearing 1900, the Board of Directors has decided to issue this next edition in seven parts, instead of six. This edition will comprise about 10,000 pages, an increase of about 20 per cent in size over the 1949 edition.

This increase would bring the present Part 5, containing standards covering textiles, soaps, fuels, petroleum, aromatic hydrocarbons and water, to unmanageable size. It has therefore been decided to limit the contents of Part 5 to fuels, petroleum, and aromatic hydrocarbons, and to place in a new Part 7 the standards covering textiles, water, and soaps. Also, standards covering paper, shipping containers, and adhesives are being transferred to Part 7 from Part 4, which will then contain standards for paint, paint materials, naval stores, and wood. There will be no change in the fields covered in Parts 1, 2, 3, and 6.

A statement of content of the seven parts is given below.

Part 1—Ferrous Metals: Carbon and alloy steels in all forms, corrosion and heat-resisting steels, metallic coatings, wrought and cast irons, ferro-alloys, magnetic materials, general methods of testing.

Part 2—Non-Ferrous Metals: Metals and alloys including aluminum, magnesium, copper, lead, nickel, zinc, die castings, solder and bearing metals, electrical heating and resistance alloys, metal powder products, electrodeposited coatings, general methods of testing.

Parts 3—Cementitious, Soils, Road and Waterproofing Materials: Cement, lime, gypsum, brick, structural tile, masonry units, building stone, mortars, concrete, refractories, pipe and drain tile, thermal insulation, glass, bituminous and non-bituminous road materials, roofing and waterproofing materials, soils.

Part 4—Paint, Paint Materials, Naval Stores, Wood: Pigments, oils and thinners, dryers, shellac, varnish and varnish materials, lacquer and lacquer materials, traffic paints, paint tests; naval stores; wood, timber preservatives, fire tests; building constructions; thermometers, general testing methods.

Part 5—Fuels, Petroleum, Aromatic Hydrocarbons: Coal, coke, gaseous fuels; fuel oils, gasoline, solvents, tests of many petroleum products for wide variety of properties; aromatic hydrocarbons; general testing methods.

Part 6—Electrical Insulation, Plastics, Rubber: All types of electrical insulating materials, tests for dielectric strength, power factor, insulation resistance, impact and other properties; tests and specifications for wide variety of plastics and compounding materials; rubber products, including hose, belting, gloves, tape, wire and cable, coated fabrics, cements, sponge and hard rubber, and tests covering many properties of rubber.

Part 7—Textiles, Water, Soaps, Paper, Shipping Containers, Adhesives: Textile materials of all types, including extensive test methods; sampling and analysis of water for determination of calcium, magnesium, chloride, hydroxide, sulfur, aluminum, silicate, magnesium, etc.; specifications, sampling, and analysis of a variety of soaps and detergents; tests and specifications for paper and paper products and for shipping containers; tests for tensile, shear, impact, cleavage strength of adhesives and resistance to chemicals; general testing methods.

This increase in size has, unfortunately, been accompanied by substantial increases since 1949 in costs of printing, binding, and mailing. It is estimated that the cost of the 1952 edition in seven parts will be between 40 and 50 per cent greater than that of the 1949 edition. To meet this situation, the Board has fixed the following *selling* prices of the 1952 edition:

	Nonmembers	Members'
Part 1	$12.00	$ 9.00
Part 2	10.00	7.50
Part 3	12.00	9.00
Part 4	10.00	7.50
Part 5	10.00	7.50
Part 6	12.00	9.00
Part 7	10.00	7.50
Complete set	$76.00	$57.00

The following annual charges for securing more than one part of the 1952 Book of Standards (and the 1953 and 1954 Supplements) on the membership, effective January 1, 1952, were also announced to the members of the Society with the bills for membership dues:

For any one part	No charge
For any two parts	$ 3.00
For any three parts	6.00
For any four parts	9.00
For any five parts	12.00
For any six parts	15.00
For all seven parts	18.00

While the bills for dues were prepared on the assumption that members getting all parts of the Book of Standards would wish to continue doing so, and that members who have been getting Parts 4 or 5 would now wish also to have Part 7, each member has been asked, if this is not in accordance with his desires, to modify his instructions to the Society and adjust the bill accordingly.

In fixing these prices and charges, the Board of Directors hopes to meet the increased costs of printing and distributing this new edition of our most valuable publication, and to maintain income from this source at a level that will, as in the past, provide the funds needed for the support and expansion of the Society's standardization activities.

NEW ASTM PUBLICATIONS

Symposium on Structural Sandwich Construction

INCLUDED in this symposium are eight highly significant papers presented at the Fifty-fourth Annual Meeting of the Society, June, 1951. Structural sandwich constructions, as usually employed, consist of laminated materials in which the faces are relatively thin, strong, and dense, whereas the cores are relatively thick, light, and considerably weaker than the faces. The more-or-less obvious objective is to obtain a structure which is strong and stiff because of its construction, but is at the same time light in weight, or has other desirable attributes not obtainable with the components used singly.

In recognition of the growing need for test methods and specifications for this relatively new field, ASTM in 1948 set up Committee C-19 on Structural Sandwich Construction. The committee arranged this symposium for the benefit of all who are interested in attaining a wider acquaintance with these important constructions. The papers are fully illustrated with charts, graphs, and photographs.

Titles and authors of the papers are as follows:

Developments and Trends in Lightweight Composite Construction—L. J. Markwardt, Assistant Director, Forest Products Laboratory, U. S. Dept. of Agriculture.

Sandwich Construction in the Elastic Range—H. W. March, Mathematician, Forest Products Laborabory, U. S. Dept. of Agriculture.

Strength of Sandwich Construction—Charles B. Norris, Engineer, Forest Products Laboratory, U. S. Dept. of Agriculture.

Compressive and Torsional Instability of Sandwich Cylinders—George Gerard, Assistant Professor of Aeronautical Engineering, New York University.

Paper Honeycomb as a Core for Structural Sandwich Construction—Edward W. Kuenzi, Engineer, Forest Products Laboratory, U. S. Dept. of Agriculture.

Aluminum Honeycomb Sandwich Construction—T. P. Pajak, Head, Sandwich Structures Unit, Materials Laboratory, The Glenn L. Martin Co.

Some Developments in Structural Sandwich Building Panels Having Inorganic Cores—G. M. Rapp, Assistant Executive Director, John B. Pierce Foundation.

Fabrication Techniques for Structural Sandwich Constructions—Bruce G. Heebink, Forest Products Laboratory, U. S. Dept. of Agriculture.

The May BULLETIN gives summaries of all the papers except that by L. J. Markwardt which is an unusually comprehensive one dealing with the whole field of sandwich constructions. After initial descriptions of research and problems in sandwich constructions, the author deals with core and facing materials. Next, under the heading, "Development of Design Criteria," he discusses wood as a prototype material, the torsion problem, plywood and the sandwich problem, and studies of honeycomb cores. Under the heading, "Adhesives and Fabricating Techniques," sections appear on synthetic resin adhesives, thermosetting and thermoplastic classification, form of adhesive and setting requirements, adhesive selection, and fabricating techniques. The final sections of the paper deal with inspection methods, specific uses and types, and the future outlook for sandwich constructions. A bibliography of over ninety references is included.

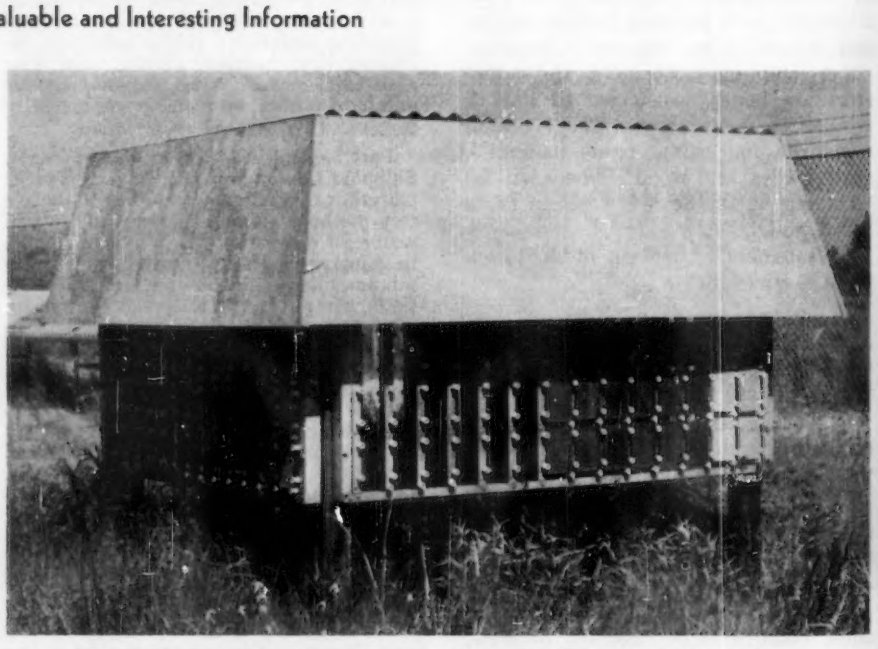
This publication, aggregating 120 pages, sells for $2.00 to nonmembers and $1.50 to members.

1952 Marburg Lecture on Corrosion Testing Published

Notable Publication Gives Much Valuable and Interesting Information

THE Society's 25th Edgar Marburg Lecture was presented by Francis L. LaQue, one of the best known authorities on the practical aspects of corrosion phenomena. His broad knowledge of the subject and his ability to discuss its many phases were quite apparent from the easy manner in which he presented his hour-long lecture to more than 500 listeners at the Annual Meeting in June.

The printed version of the lecture entitled "Corrosion Testing" covers more than 90 pages and is profusely illustrated, ranging from such things as "Larrabee's Hen House" (Fig. 6), which was designed to study the effect of degree of shelter and orientation on corrosion of carbon steel, to the effects of velocity of sea water on brass and copper-nickel (Fig. 62). The lecture is supplemented by a comprehensive list of 95 references.



"Larrabee's Hen House," designed to study the effects of partial shelter on atmospheric corrosion of steel.

The best known type of corrosion is atmospheric corrosion, although few people realize that the degree of corrosion or weight loss of specimens is directly related to the rust color. LaQue also showed by specimens exposed on the structure designed by C. P. Larabee, that the degree of shelter does not necessarily indicate the degree of corrosion. Another prevalent belief is that the corrosivity of various materials in relation to one another is the same at various localities. This paper shows that in a rural atmosphere such as at State College, the weight loss of lead and zinc specimens was practically the same, whereas in New York the weight loss of zinc specimens was nearly 7 times that of the lead.

In his discussion of immersion tests he pointed out the effects of a small anode in combination with a large cathode. An example would be the use of steel rivets in joining copper plates. The rapid corrosion of the steel rivets would result in early failure, whereas the reverse case, that of using copper rivets in joining steel plates, would result in a much longer service life due to the relatively large area of the anode (steel) in the second case as compared with the case of the steel rivets.

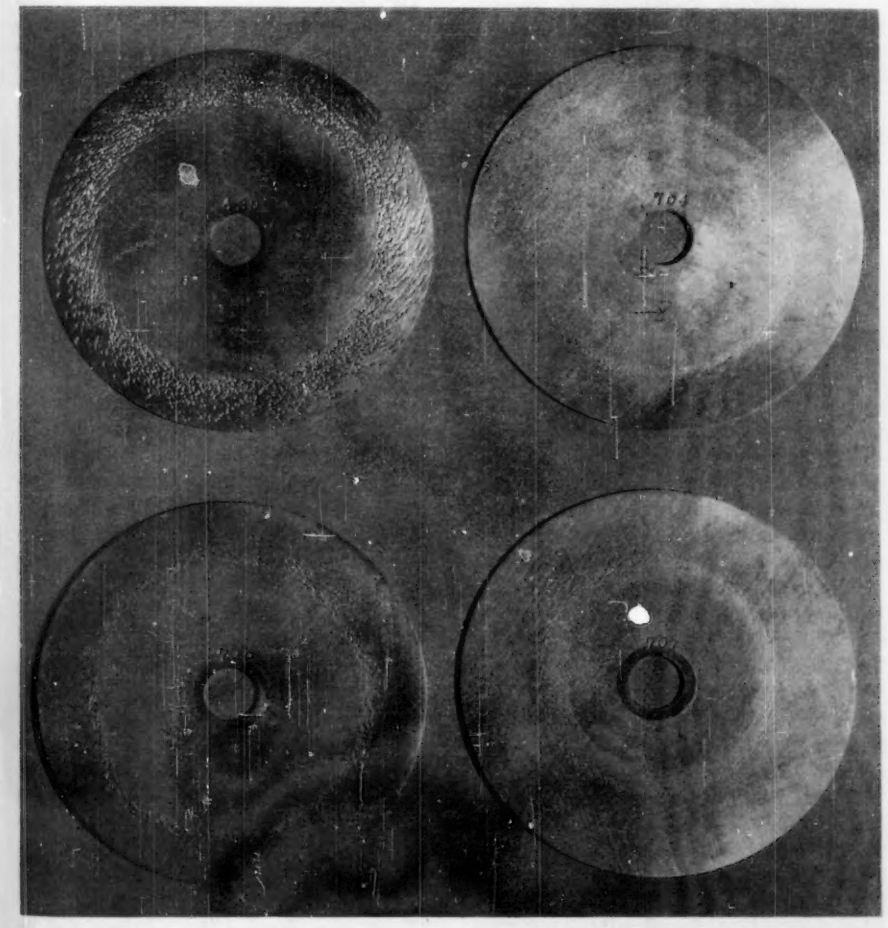
The conclusions concerning the inadvisability of comparing the corrodibility of various materials under different atmospheric exposure conditions apply also to the undesirability of using a single salt brine to determine the corrodibility of different materials in the salt-spray test. For example, open-hearth iron is more severely attacked by 3 per cent sodium chloride than by a 20 per cent solution, whereas with zinc, the reverse is true. LaQue also indicated that the salt-spray test has often been incorrectly used to evaluate susceptibility of materials to marine atmospheres. He pointed out that one of the most acceptable methods for performing laboratory total immersion tests is the ASTM Tentative Method of Total Immersion Corrosion Test of Non-Ferrous Metals (B 185–43 T) which was checked by round-robin testing in Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. Reproducibility was found not only among specimens in a particular test but from test to test undertaken at different times.

In directing plant corrosion tests, he emphasized six special points in planning tests and interpreting results, a number of which are probably not usually considered—for example, the fact that aluminum may suffer and stainless steel benefit from the presence of copper in the corrosion process of adjacent specimens.

In conclusion LeQue stated:

"This emphasis on corrosion should not give the readers a false impression that corrosion tests are characteristically unreliable. Corrosion testing procedures used or sponsored by ASTM committees compare favorably with other kinds of tests when they are executed carefully and interpreted intelligently."

The printed lecture covers some 40 main divisions of the subject. It should be of widespread interest and value. In advance of its inclusion in the 1951 *Proceedings* (about March, 1952) it has been published as a separate item—list price, $1.50; to members, $1.15.



Admiralty Brass
70–30 Copper-Nickel, 0.5 per cent iron

90–10 Copper-Nickel, 0.8 per cent iron
70–30 Copper-Nickel, 0.05 per cent iron

Corrosion Specimens from Rotating Spindle Test in Sea Water.

Statistical Aspects of Fatigue

THE value of a statistical approach to physical testing has long been recognized. However, the first session of papers devoted exclusively to the statistical aspects of fatigue was presented at the 54th Annual Meeting of the Society in June, 1951, under the auspices of Committee E-9 on Fatigue. These papers are being published as a Special Technical Publication No. 121. This publication includes three papers and two prepared discussions. The three papers comprising this group are "Planning and Interpretation of Fatigue Tests" by A. M. Freudenthal, Columbia University; "On the Statistical Nature of Fatigue" by F. B. Stulen, Curtiss Wright Corp.; "Statistical Analysis of Fatigue Data" by Robert Plunkett, Hughes Tool Co. The two prepared discussions are by E. Epremian of the Carnegie Institute of Technology and J. T. Ransom of the E. I. du Pont de Nemours, Inc.

Freudenthal's paper dealt with the statistical aspects of fatigue with respect to the planning of fatigue tests and interpretation of results. Theoretical concepts were introduced on the basis of which the characteristics of the scatter of fatigue data can be interpreted.

Stulen developed hypotheses to explain the effect of size on endurance limit, fatigue life, and notch sensitivity. Plunkett's paper deals with a statistical

analysis of experimental data and gives a method for plotting the curve of a constant which represented the fraction of a total number of specimens that fell at or below a certain number of cycles.

The introduction of this group of papers was prepared by R. E. Peterson, Westinghouse Electric Corp. and Chairman of Committee E-9 on Fatigue.

Copies of the 50-page book can be procured at the list price of $1.75. The price to members is $1.35.

Thermal Insulation Symposium Published

THE SYMPOSIUM on Thermal Insulating Materials, which was presented at the 1951 Spring Meeting of the Society in Cincinnati and received with widespread interest, is now available as a special publication. Sponsored by Committee C-16 on Thermal Insulating Materials, the symposium consists of five papers.

In two of the papers H. E. Robinson, National Bureau of Standards, and Charles F. Gibbs, Armstrong Cork Co., discuss the guarded hot plate method of determining thermal conductivity (ASTM Method C 177), which is recognized throughout the industry as an acceptable means of evaluating this major property of insulation.

The problem of the presence of water and water vapor in the walls of frame dwellings is recognized as an important one, and basic concepts of water vapor migration and their application to frame walls are discussed by F. A. Joy of Pennsylvania State College.

The subjects of surface emittance and specific heat are covered in the remaining two papers prepared by L. P. Herrington and Norman H. Spear, both of the John B. Pierce Foundation. Appropriate methods for measurement of surface emittance are described including that for infrared heat emission and absorption of structural materials. The measurement and significance of specific heat is illustrated by examples which include an analysis of the effect of specific heat on the performance of building structures subject to different temperature cycles. Protective clothing is described in respect to the engineering properties thereof.

The symposium (STP No. 119) containing 64 pages is available in heavy paper cover at $1.50, to members at $1.15.

Symposium on Bulk Sampling

Covers One of Industry's Important Problems

"THE sampling of bulk materials is one of the most important technical problems in industry. Vast sums of money change hands every day on the basis of samples," states Dr. W. Edwards Deming in his introduction to the present Symposium. He also remarks that, "probably no branch of science has expanded so rapidly and outgrown its shell so many times in the past ten years as the science of sampling. In ASTM much valuable work in this field is being done by Task Group No. 7 of Committee E-11 on Quality Control of Materials whose specific assignment is:

"To study and report on the problems of sampling materials that occur in bulk form or in packages, with the aim of estimating, at minimum cost, measurable characteristics of a quantity of material in order to get some prescribed limit of error with an assigned probability. Special attention should be given to the three problems:

1. To describe a method whereby bulk materials can be sampled to produce knowledge of average with measurable error.
2. To describe a method of sampling whereby constancy of property within the bulk can be determined.
3. To describe a method of handling bulk materials whereby the desired constancy between incremental portions at the point of consumption can be maintained."

The present symposium, sponsored by Task Group No. 7, consists of six papers whose titles and authors follow:

Materials Handling for Bulk Sampling.—J. Manuele, Director, Headquarters Quality Control, Westinghouse Electric Corp., Pittsburgh, Pa.

Economic Accumulation of Variance Data in Connection with Bulk Sampling.—L. Tanner and M. Lerner, Chief and Assistant Chief Chemist, U. S. Customs Laboratory, Boston, Mass.

Two-Stage Acceptance Sampling by Attributes.—C. W. Dunnett, Statistician, Food and Drug Divisions, Department of National Health and Welfare, Ottawa, Canada, and J. W. Hopkins, Biometrician, Division of Applied Biology, National Research Council, Ottawa, Canada.

Coal Sampling Problems.—A. A. Orning Coal Research Laboratory, Carnegie, Institute of Technology, Pittsburgh, Pa.

The Analysis of Variance in Sampling Experiment.—W. M. Bertholf, Efficiency Engineer, By-Product Coke Plant, Colorado Fuel and Iron Corp., Pueblo, Colo.

The Design of Coal Sampling Procedures.—W. M. Bertholf, Efficiency Engineer, By-Product Coke Plant, Colorado Fuel and Iron Corp.

The Symposium totalling 70 pages is available in heavy-paper cover edition to nonmembers at $1.75, to members at $1.35.

50-Year Index to Mark 50th Anniversary of Society

COINCIDENT with the forthcoming 50th Anniversary Meeting of the ASTM, the Society has before it as a publication project a 50-year Subject and Author Index of all its technical publications up to and including those presented in 1950. (This will include the papers published by the American Section of the International Association for Testing Materials between 1898 and 1902.)

To ascertain what form such a comprehensive index should take, a meeting was held recently to discuss the problems involved, with representatives present from the libraries of Bell Telephone Laboratories, E. I. du Pont de Nemours, Franklin Institute, and Battelle Memorial Institute.

As a result of this meeting, a tentative plan was adopted and submitted to a representative cross-section of the Society for comments. A number of constructive criticisms were received and based on these, decisions have been made on the method of indexing to be used.

There has not been issued since 1940 any combined index to the Society's reports and technical papers. Prior to that time there were five indices covering the *Proceedings* from 1898 and since 1936, other technical publications. Thus there has developed a persistent demand for this new index. It should be noted that it will index *all* of the Society's technical publications where papers and reports appear, not only the *Proceedings*, but the STP's, and in fact some of the special compilations of standards. While a tremendous amount of work is involved, this publication is being expedited in the hope that it can be available for distribution before the Society's Fiftieth Anniversary Meeting, June 23-27, in New York City. Prices will be announced later, but members will be given the customary privilege of procuring copies at reduced prices.

Triaxial Testing of Soils and Bituminous Mixtures

THIS 300-page publication is a compilation of papers presented at the Fifty-third Annual Meeting of the Society and three of those presented at a session on Bituminous Paving Mixtures at the First Pacific Area National Meeting in San Francisco.

Subcommittee R-5C on Methods of Testing Soils Under Triaxial Loading of ASTM Committee D-18 on Soils for Engineering Purposes has devoted much time to discussions of the various concepts prevailing with respect to shear testing of soils and to testing equipment and procedures, realizing that standardization of a triaxial shear test may not be accomplished for many years. The 1950 Annual Meeting symposium was designed by the subcommittee to bring out some of the current thinking on the subject.

Several papers in the symposium and the three papers from the Pacific Area Meeting on applications of the triaxial test to bituminous mixtures are included because of the close similarity of problems involved in testing soils and bituminous paving materials under triaxial loading.

The papers from the San Francisco meeting were prepared by members of the Triaxial Institute, an informal group of West Coast engineers who are also members of Subcommittee B-2 on Physical Tests for Compressed Bituminous Mixtures of Committee D-4 on Road and Paving Materials.

One additional paper with discussion by W. S. Housel, which was originally presented before the Association of Asphalt Paving Technologists at St. Louis in 1950, has been included to round out the discussion on triaxial testing.

Titles and authors of the papers are as follows:

The History and Theory of Triaxial Testing, and the Preparation of Realistic Test Specimens—A Report of the Triaxial Institute—V. A. Endersby.

Some Concepts Concerning Triaxial Compression Testing of Asphaltic Paving Mixtures and Subgrade Materials—F. N. Hveem and Harmer E. Davis.

Application of the Triaxial Test to Bituminous Mixtures California Research Corporation Method—V. R. Smith.

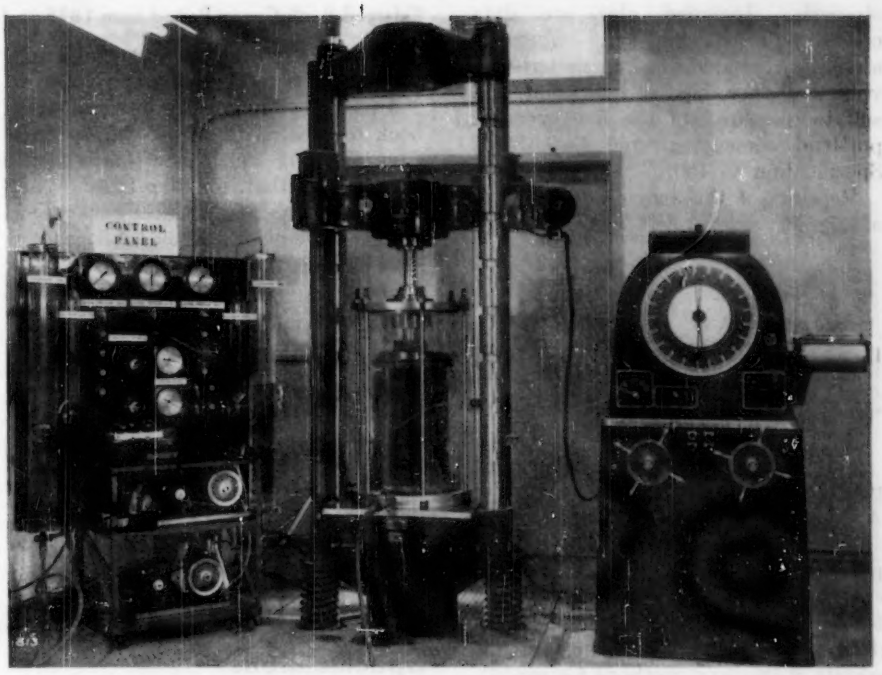
Application of Triaxial Testing to the Design of Bituminous Pavements—Norman W. McLeod.

Triaxial Design Correlated with Flexible Pavement Performance in Kansas—H. E. Worley.

Triaxial Testing Adapted to Soils, Flexible Base, and Foundations—R. J. Hank.

A Triaxial Apparatus for Testing Large Soil Specimens—Earl B. Hall.

Shear Testing at the Waterways Experiment Station—Stanley J. Johnson.



Assembled triaxial shear apparatus and specimens preparatory to stress application.

A Triaxial Shear Investigation on a Partially Saturated Soil—Donald W. Taylor.

Shear Characteristics of Remolded Earth Materials—A. A. Wagner.

Application of Triaxial Compression Test Results to Highway Soil Problems—E. S. Barber and C. L. Sawyer.

The Importance of Natural Controlling Conditions Upon Triaxial Compression Test Conditions—Donald M. Burmister.

Interpretation of Triaxial Compression Tests on Granular Mixtures—W. S. Housel.

The 303-page publication, in heavy paper cover, sells for $3.50; $2.60 to ASTM members.

Changes in Portland Cement from 1904 to 1950

A PAPER presented at the last Annual Meeting of the Society is now available in reprint form entitled, "Changes in Characteristics of Portland Cement as Exhibited by Laboratory Tests Over the Period of 1904 to 1950" by H. F. Gonnerman and William Lerch, both of the Portland Cement Assn. This very significant and interesting presentation, as indicated by the title, includes a comprehensive collection of data covering a period of 46 years during which time the portland cement industry has grown to major proportions in the country. This growth in no small way is due to the great amount of research and testing which has been carried on by the Portland Cement Assn. and by the many state highway departments, governmental agencies, and universities.

In tracing down through the years the changes and improvements which have been made in portland cement, especially Type I, which is the most commonly used, it is interesting to note that most of these changes occurred during the period from 1926 to 1940. With an increase in the average computed C_3S content and in fineness, Type I cements have attained a strength of 3000 psi in about 4 days and 60 00 psi in about 40 days, whereas it required about 28 days and 8 years respectively to attain these strengths in comparable concretes during the period 1916 to 1920. With this accelerated rate of early strength, however, it has been found that the gain in strength of moist-cured concrete from 28 days to 10 years has remained approximately the same.

The authors show through their data that cements made in 1904 showed wide variation in composition, a condition that continued until 1926.

Comparative data are presented on such properties and conditions as the percentage of water required to produce

neat cement pastes, time of setting, tensile strength, and compressive strength. Included also are data comparing composition, fineness, strength producing characteristics, volume change, heat of hydration, and sulfate resistance of the five types of portland cement covered by ASTM Specification C 150.

Reprints of this paper are available at $1; 75 cents to ASTM members.

Papers on Evaluation of Soaps and Detergents

THIS compilation of papers presented at a 1951 meeting of ASTM Committee D-12 on Soaps and Other Detergents represents a part of the continued effort of the committee to bring to its members new techniques for evaluation of soaps and detergents. Although the literature is replete with many methods for evaluation of these materials, the methods used frequently tend to measure either individual properties or to measure the combined properties of a material with the result that it has been difficult to obtain agreement upon evaluation methods.

The first part of the compilation contains the following papers:

Practical Evaluation of Soiled Test Pieces—R. B. Mitchell.
Measurement of the Adsorption of Anion-Active Detergents by Materials Commonly Washed—W. A. Fessler.
Laboratory Performance Test for Detergents in Continuous Wool Scouring—E. A. Leonard.
A Metal Cleaning Test Using Radioactive Stearic Acid as Soil—J. W. Hensley, H. A. Skinner, and H. R. Suter.
An In-Vivo Method for Determining the Degerming Efficiency of Soaps Containing Hexachlorophene—A. R. Cade.

The second part on Wetting Test Methods, which includes "The Mechanism of the Wetting of Textiles" by I. J. Gruntfest, summarizes a symposium arranged by Subcommittee T-5 on Physical Testing.

The Draves Wetting Test Method—Carl Z. Draves.
The Tape Wetting Test Method—L. Shapiro.
The Canvas Disk Method—O. M. Morgan.
The Hydrometer Wetting Test Method—H. B. Walker.

This 64-page publication with an Introduction by J. C. Harris, Chairman of Committee D-12, is listed at $1.50; to members, $1.15.

200-Page Bibliography on Electrical Contacts

Enlarged Book Covers Period from 1835 to 1951

THIS is an augmented and extensively revised bibliography of over 200 pages combining the original 1944 book together with its six supplements and including much new material in addition to that for the latest year. The intensive and time-consuming efforts of the Section of Bibliography headed by E. I. Shobert II, and his associates, this group functioning under ASTM Committee B-4 on Electrical Heating, Resistance, and Related Alloys, has been highly commended because it makes it possible for everyone concerned with electrical contacts to keep currently up to date with the latest information. Not only are the literature references cited, but expertly prepared abstracts constitute a most valuable part of the Bibliography.

Covering the period from 1835 up through most of 1951, this book ranges over the entire development in this field. There are over 1000 references and hundreds of abstracts with references to the original sources, dates, and page numbers. Many special articles are included in the Bibliography to make it of real service, among them articles on contact materials and methods of testing and interruption of electrical circuits.

Copies of this 225-page compilation can be procured through ASTM, 1916 Race Street, Philadelphia 3, Pa. The price will be announced. It will be ready about March.

Additional Changes Forthcoming in High-Temperature Pipe Specifications

REVISIONS are in prospect in eight of the important piping materials specifications for high-temperature service that were included in the Part 1, 1951 Supplement to the Book of Standards. In addition to changes approved at the Annual Meeting, the subcommittee responsible in Committee A-1 on Steel reached agreement late in the year on some important changes that could not be included in the 1951 Supplement. While the modifications are not of a major nature, the consumers and producers concerned with the materials covered in these widely used specifications feel they are extremely significant.

Separate copies of the specifications in question will be struck off, and they will also be included in their latest form in the 1952 Compilation of Specifications for Steel Piping Materials, to be issued in February. (Publication of this is imminent, and copies of the 370-page book can be procured from ASTM Headquarters at $3.50 list; $2.65 to members.)

The specifications in which additional revisions are to appear are:

Seamless Alloy-Steel Pipe for High-Temperature Service (A 158–51 T)
Seamless Carbon-Molybdenum Alloy-Steel Pipe for High-Temperature Service (A 206–51 T)
Seamless Chromium-Molybdenum Alloy-Steel Pipe for Service at High Temperatures (A 280–51 T)
Seamless 1 Per Cent Chromium, 0.5 Per Cent Molybdenum Alloy-Steel Pipe for Service at High Temperatures (A 315–51 T)
Seamless Carbon-Steel Pipe for High-Temperature Service (A 106–51 T)
Electric-Fusion-Welded Steel Pipe for High-Temperature and High-Pressure Service (A 155–51)
Factory-Made Wrought Carbon and Alloy Steel Welding Fittings (A 234–51 T)
Seamless Ferritic Alloy Steel Pipe for High-Temperature Service (A 335–51 T)

A note concerning this situation was included with each copy of the 1951 Supplement to Part 1.

(In addition to these specifications, a change in the hydrostatic test pressure requirements of pipe specification A-53 is being approved in Committee A-1 providing for the elimination of the holding time of 5 minutes. This requirement applicable to seamless material should not have been included in the 1951 version of A-53, and its deletion will shortly be recommended, providing relief to many butt weld mills.)

The Staff, collectively, and the individual members, appreciate greatly the many Christmas cards and expressions of good will received during the holiday season. It is a great privilege to work for and with the people who comprise ASTM.

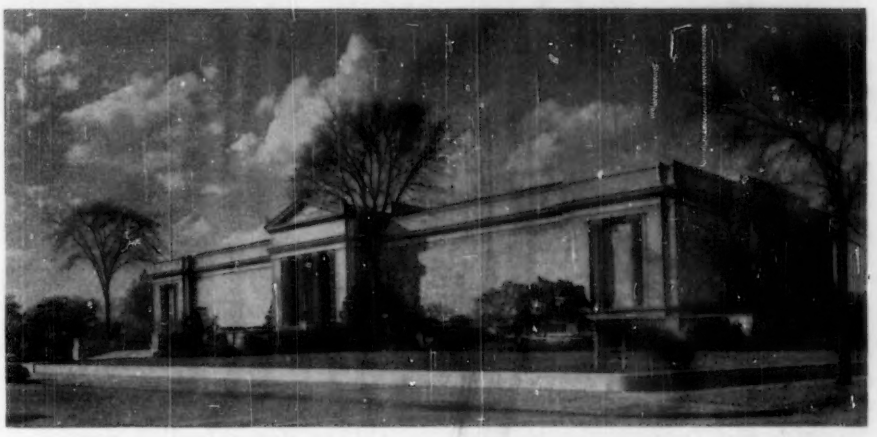
Symposium on Testing Metal Powders and Products to Feature Spring Meeting; Reception and Dinner

President Fuller and A. F. Rupp, Oak Ridge National Laboratory, to Speak; Many Meetings During Committee Week in Cleveland, March 3–7

As previously announced, the technical feature of the 1952 Spring Meeting being held at the Hotel Statler in Cleveland on Wednesday, March 5, is to be a Symposium on Testing Metal Powders and Metal Powder Products. Sponsored by ASTM Committee B-9 there are at least six authoritative papers scheduled for presentation. The symposium will get under way at 10 a.m.

President Fuller and A. F. Rupp, Oak Ridge National Laboratory, to Speak at Cleveland Dinner

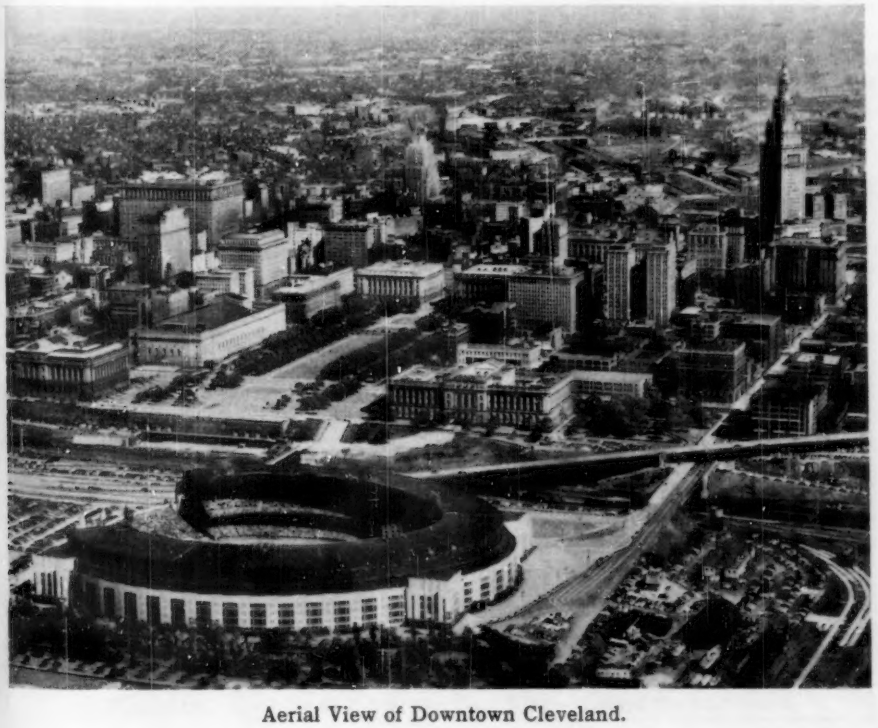
Following this symposium late in the afternoon, there is to be a President's reception and cocktail party complimented to those attending the dinner under the auspices of the Cleveland District. President Fuller and other officers will be there, and also at the dinner to follow. An informative program is scheduled for the dinner with President Fuller giving a somewhat condensed version of his interesting talk on "Solving Problems in Materials" to be followed with a short address by A. F. Rupp, Superintendent, Radioisotope Development Dept., Oak Ridge National Laboratory, on "Engineering for Radioisotopes." Following his talk there is to be an intriguing film short showing the handling and other interesting phases of this work. There were so many favorable comments on this talk and film as a result of its presentation in late 1951 in Boston that the Cleveland District felt it would be of widespread interest to all those at the Spring meeting.



The Cleveland Museum of Art.

A combined notice and dinner reservation form are being mailed to all members. This affair will be interesting and well worth while.

Please assist the Cleveland District Council by making dinner reservations early.



Aerial View of Downtown Cleveland.

Metal Powders Symposium

Sponsored by ASTM Committee B-9 on Metal Powders and Metal Powder Products, the symposium will be presented on Wednesday, March 5. The work of Committee B-9 in the rapid progress of powder metallurgy as a production method has resulted in a number of standard specifications and tests. The technical aspects of this comparatively new field have received considerable attention but it is believed that this is the first symposium specifically concerned with methods of testing. Tentative titles of the proposed papers in the symposium are given below:

Symposium on Testing Metal Powders and Products

Methods and Devices for Testing Sintered Iron Rotating Bands, by John D. Dale, Frankford Arsenal.

Permeability and Strength of Porous Stainless Steel Compacts, by F. V. Lenel and O. W. Reen, Rensselaer Polytechnic Institute.

Survey of Methods for Testing Cemented Carbide Compositions, by J. C. Redmond and A. D. Stevens, Kennametal, Inc.

Particle Size Measurement of Metal Powders by the Air Elutriation Method by P. S. Roller of Hyattsville, Md.

Cleveland Public Square.

Particle Size Determination in Metal Powders, by R. P. Seelig, American Electro Metal Corp.

Quality Control on Structural Parts Made from Metal Powders, by T. J. Snodgrass and W. A. Hinkle, General Electric Co.

Committee Week

Twenty-eight main committees have thus far signified their intention of holding general or subcommittee meetings during Committee Week in an effort to clear much of their research and standards work in March.

Committees scheduled to concentrate their meetings in the week of March 3 are listed below. Further information on hotel reservations and a detailed main committee schedule are currently going out to members by direct mail.

The following committees are scheduled to meet:

A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-7 on Malleable-Iron Castings
A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys
B-2 on Non-Ferrous Metals and Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-6 on Die-Cast Metals and Alloys
B-7 on Light Metals and Alloys, Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
B-9 on Metal Powders and Metal Powder Products
C-1 on Cementitious, Ceramic, Concrete, and Masonry Materials
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-12 on Mortars for Unit Masonry
C-15 on Manufactured Masonry Units
C-16 on Thermal Insulating Materials
C-17 on Asbestos-Cement Products
C-22 on Porcelain Enamel
D-1 on Paint, Varnish, Lacquer, and Related Products
D-4 on Road and Paving Materials
D-5 on Coal and Coke
D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-like Materials
D-16 on Industrial Aromatic Hydrocarbons
D-18 on Soils for Engineering Purposes (Includes a papers session)
D-19 on Industrial Water
E-1 on Methods of Testing (Subcommittees)
E-5 on Fire Tests of Materials and Construction
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-10 on Radioactive Isotopes
E-12 on Appearance

Radioactive Isotopes in Soil Investigation

A group of papers dealing with the use of radioactive isotopes in soil investigation will provide an interesting feature of the meeting of Committee D-18 on Soils for Engineering Purposes. A list of titles is not available at this time. Committee D-18 cordially invites all interested persons to hear this program on Wednesday afternoon, March 5.

It is interesting to note also that other coverage of this new development—the use of radioactive isotopes—during the week, will be a scheduled meeting of the newly formed Committee E-10 on Radioactive Isotopes, and as the subject of a featured talk to be given at the Dinner on Wednesday evening, March 5.

Why Am I an ASTM'er?

A PORTION of a letter from the files at ASTM Headquarters, one of many which have been assembled for the use of the new Administrative Committee on Member, Industry, and Public Relations, is given below. Other such statements from active members of ASTM will be used from time to time in the BULLETIN.

From a Director of Research in the Middle West—

. . . I am taking the liberty of giving you my experience as to the benefits of ASTM based on membership for approximately twenty-five years. It seems to me that one of the main benefits of ASTM is the personal contacts and discussions at the annual meetings and at the committee meetings. These contacts, together with active participation in the work of the subcommittees, are very stimulating and serve to keep one much better abreast of the latest developments in testing methods and specifications than is possible in any other way. As a result, one gains advance information regarding developments in the fields of testing and specifications. Although the ASTM meetings are conducted in a very businesslike manner, they afford some opportunity for relaxation and the annual renewal of friendships has proved a great satisfaction to me. It is generally accepted that the work of the Society is essential to American industry and that its benefits extend to all phases of industry. It seems to me that all of us should lend support to an organization that is working for our benefit.

New York Committee Planning Trip Data for Fiftieth Anniversary Meeting

ALTHOUGH no action is called for at the moment, it will be of interest to many members to know something about the plans of the New York Committee on Arrangements for laboratory visits during the period June 23–27, 1952, when the Fiftieth Anniversary Meeting will be under way in New York. A Trips Subcommittee, headed by Lincoln T. Work, Consulting Engineer, 2128 Graybar Building, New York 17, recently considered the most logical setup for providing interesting laboratory visits. Based on their discussions, a list is to be prepared in consultation with New York District members, of laboratories which would have features—such as unusual equipment, special buildings, etc.—of interest to the members. When this list is compiled and reviewed by the Trips Committee, additional data (including the name of a contact man at the respective laboratories, suggested time of visits, etc., and a keyed list of interesting features) will be prepared and furnished to the membership through the ASTM BULLETIN, and possibly separately. Information on how to get to the laboratories will also be given.

The committee feels that with this information, supplemented by knowledge of the time of the technical sessions and information on the general time of technical committees, a member can work in such visits as desired. The committee is prepared, should there be a reasonable number of members wishing to visit a particular laboratory, to schedule a definite trip, but from past experience feels that in general members may wish to schedule their own visits at convenient times.

There are a large number of unusually interesting laboratories, many of them relatively new, within commuting distance of New York, and the committee hopes to include many of these in its list.

By furnishing the members information well in advance, through the April BULLETIN, it is felt the committee will be rendering a service that many will appreciate.

1952 Lecturers Announced; Outstanding Edgar Marburg and Gillett Memorial Lectures in Prospect

R. C. McMaster and N. L. Mochel Will Speak

Two significant lecturers are in prospect for the Fiftieth Anniversary Meeting to be held in New York during the week of June 23–27, 1952. Dr. R. C. McMaster, Battelle Memorial Institute, will deliver the Edgar Marburg Lecture on the subject "Non-Destructive Testing." A most active worker in this field, he serves on Committee E-7 on Non-Destructive Testing and is in close touch with important developments. He has established a high rating for clear and effective presentation.

The first H. W. Gillett Memorial lecture, the establishment of which was announced in the December BULLETIN, is to be given by Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp. He will speak on "Man, Metals and Power." Mr. Mochel is expected to include, as a portion of his lecture, the background of some of the outstanding work done by Dr. Gillett, and in keeping with Gillett's chief interest, the critical evaluation of metals and alloys, it is anticipated the lecturer will devote a major portion of his address to the use of materials in the field of power generation, including high temperature and related applications. Further information, including biographical data of the lecturers, synopses of the lectures, and like material, will appear in subsequent BULLETINS.

In the meanwhile, members who have not earmarked their calendars for the week of June 23, 1952, are urged to do so, and those concerned with both ferrous and non-ferrous metals will want to note especially Monday and Wednesday afternoons, June 23 and 25, when the Gillett and the Marburg Lectures will be presented, respectively.

Manhattan—Looking at it over the East River—toward the northwest.

Textile Session at Annual Meeting

THE complete Provisional Program for the Society's Fiftieth Anniversary Meeting will be published in the May BULLETIN, and members can look forward to that for a complete picture of detailed information on the large number of papers and reports to be presented. Meanwhile, certain issues of the BULLETIN have included advance information; for example, December, on page 9, listed papers in six of the symposiums and the February and April BULLETINS will give further details.

Textile Papers:

Meanwhile it can be announced that through the initiative of Committee D-13 there is to be a distinctive session devoted to several papers in the field of textiles. The plan here is to provide latest information on certain outstanding topics. Those provisionally in mind are the following:

Application of Statistics to Quality Control in the Textile Industry—Robert Jones, in Charge of Quality Control, Bigelow-Sanford Co.

Status of Synthetic Textiles—Their Promise for the Near Future—C. W. Bendigo, American Cyanamid Co.

An Engineering Approach to an Understanding of the Properties and Utilization of Textile Fibers—W. J. Hamburger, Fabric Research Laboratories, Inc.

ASTM Bulletin

JANUARY 1952

NO. 179

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

A Valuable Service

"Midnight Oil as an Ingredient"

WHEN there are several thousand men in an organization devoting considerable time, effort, and brains to important work, it is perhaps dangerous to compliment any particular group of individuals. Yet somehow we feel a few words of commendation should go to some who have been burning "midnight oil" in the interests of specific fields in which they have done much devoted work. We refer to certain new bibliographies and revised groups of abstracts and compilations of data.

There will soon be issued an extensively amplified bibliography on "Photoelectric Spectrophotometric Methods of Analysis for Inorganic Ions (II)," prepared by Messrs. J. W. Stillman and E. C. Dunlop. With increased emphasis on the use of spectrophotometry in various fields, here is a compact list of references that both the veteran and the new worker in this field will find of much value.

J. C. Harris has submitted a voluminous manuscript to bring up to date the abstracts on metal cleaning. This current supplement to the original bibliography has a great wealth of material boiled down and carefully edited.

In the works is an extensively amplified and revised bibliography and abstracts on electrical contacts, initiated and spark-plugged by Earl I. Shobert II and his associates of Committee B-4. This latest book of over 200 pages will include the original '44 book, plus the six supplements issued since, plus much new material.

The Joint Committee on Effect of Temperature is issuing soon a valuable and urgently needed compilation on high-temperature properties of stainless and related steels so widely used in high-temperature and high-pressure work. Much of the spade work—compilation of data, preparation of drawings, etc.—was done under contract at Battelle Memorial Institute, but we know that Ward F. Simmons, associated with this project, put in many extra hours of personal interest.

Down through the years many others have contributed to ASTM works of this kind.

Many feel that the compilations of data, the correlated abstracts, the extensive bibliographies which ASTM produces from time to time (and in late years, with increasing frequency) are one of its most valuable contributions. Obviously, what ASTM produces is, in simplified form, the contributions of its members and committee people. We know that in preparing these publications, there is a tremendous amount of time put in "above and beyond the call of duty." We trust that those mentioned above, who include in their many activities the chairmanship or vice-chairman of three main ASTM committees among other problems, will feel that the ensuing publications and the reception accorded them, will give some gratification for their efforts. The many workers in the fields covered will certainly benefit inestimably from these contributions.

(And perhaps this brief note may bring a bit of solace for the folks at home who, as we well know, often wonder whether all the "outside" work that is done is appreciated!)

Schedule of ASTM Meetings

DATE	GROUP	PLACE
January 28–31	Committee A-1 on Steel	Philadelphia, Pa.
January 30–31	Committee B-5 on Copper and Copper Alloys, Cast and Wrought	New York, N. Y.
February 3–8	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C.
February 5	Philadelphia District	Philadelphia, Pa.
February 22	Committee D-6 on Paper and Paper Products	New York, N. Y.
February 25–27	Committee D-20 on Plastics	Philadelphia, Pa.
February 27–29	Committee D-9 on Electrical Insulating Materials	Philadelphia, Pa.
February 29	New York District	New York, N. Y.
March 3	Pittsburgh District	Pittsburgh, Pa.
March 3, 4, 5, 6 & 7	ASTM COMMITTEE WEEK	Cleveland, Ohio
March 5	Spring Meeting (Cleveland District)	Cleveland, Ohio
March 5	C-3 on Chemical-Resistant Mortars	Philadelphia, Pa.
March 5	E-13 on Absorption Spectroscopy	Pittsburgh, Pa.
March 12	Chicago District	Milwaukee, Wis.
March 31–April 1	Committee D-10 on Shipping Containers	Atlantic City, N. J.
May 6	Board of Directors	Philadelphia, Pa.
May 13	Committee E-11 on Quality Control of Materials	Philadelphia, Pa.
June 23–27	ASTM ANNUAL MEETING—FIFTIETH ANNIVERSARY; APPARATUS EXHIBIT	New York, N. Y.

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

ASTM 25 Years Ago

In beginning a new year of ASTM activity, it may be appropropriate to look back briefly to the January, 1927, issue of the ASTM BULLETIN in which the events of 1926 were summarized and commented upon. It is interesting to note that except for minor changes, this summary could be used in present issues of the BULLETIN.

"The year 1926 was an eventful one for the American Society for Testing Materials. Its technical activities have gone forward with as rapid a pace and have been as productive as at any time in the Society's history. Much of this has been due to its committees for they are the life of the Society. Of these committees there are now 45, a new Committee on Natural Building Stones having been organized during the year. A number have found it necessary to increase their membership in view of the diverse subjects now receiving their attention, the membership of the committees now totaling 2100. An idea of the virility and activity of these committees may be gained from the reports presented at the annual meeting, reports having been received from 36 of the committees."

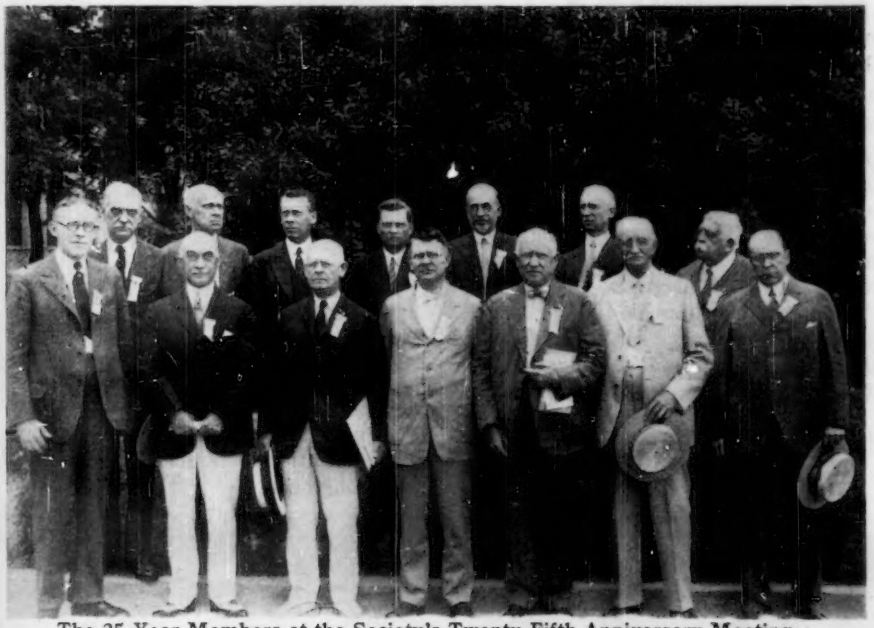
STAFF NOTE: One might wish for those good "old" days. Now with probably more than 1500 committees including main, subs, and sections, etc., with 500 to 600 meetings during the week-long Annual Meeting and hardly a week going by without a half-dozen or so technical meetings somewhere in the country, the problem of providing facilities, coordinating the work, editing and so forth, is enormous. But with an experienced and conscientious group of committee officers, an understanding committee membership, reasonable yet effective regulations that do not lessen unduly the considerable autonomy in each technical committee, these seemingly hectic activities work out reasonably smoothly (it is believed).

ASTM 50 Years Ago

Bulletin No. 86 dated July, 1901, notes under the heading "Letter Ballot on Specifications" that the "American Section of the International Association for Testing Materials" hereby adopts as standards the ten specifications as published in the revised Bulletins Nos. 8 to 16 and No. 24. The titles of these standards are as follows:

Proposed Standard Specifications for:

Bulletin No. 8—Structural Steel for Bridges and Ships
Bulletin No. 9—Structural Steel for Buildings
Bulletin No. 10—Open-hearth Boiler
Bulletin No. 11—Steel Rails
Bulletin No. 12—Steel Splice Bars
Bulletin No. 13—Steel Axles
Bulletin No. 14—Steel Tires
Bulletin No. 15—Steel Forgings
Bulletin No. 16—Steel Castings
Bulletin No. 24—Revised Standard Specificatious for Wrought Iron



The 25-Year Members at the Society's Twenty-Fifth Anniversary Meeting At French Lick Springs, Indiana, in 1927.

Every one of these men made outstanding contributions to the Society, and many were honored either by election to Society office or became Honorary Members. For the information of those interested, we have included the primary professional connection or activity of these men. From l. to r. back row: H. V. Willie, Vice-President, The Baldwin Locomotive Works; H. E. Smith, Engineer of Tests, New York Central Lines; Allan W. Dow, Paving and Chemical Engineer; R. S. MacPherran, Chief Chemist, Allis-Chalmers Manufacturing Co.; T. D. Lynch, Manager, Materials and Process Engineering, Westinghouse Electric and Manufacturing Co.; Jesse J. Shuman, Inspecting Engineer, Jones and Laughlin Steel Corp.; A. H. Sabin, Chemist, Flushing, N. Y. From l. to r. front row: C. N. Forrest, Manager, Technical Department, The Barber Asphalt Co.; G. H. Clamer, President and General Manager, The Ajax Metal Co.; A. A. Stevenson, Vice-President, Standard Steel Works; J. A. Capp, Engineer of Materials, General Electric Co.; Samuel Tobias Wagner, Chief Engineer, Reading Co.; Arthur N. Talbot, Professor of Municipal and Sanitary Engineering, and in Charge Theoretical and Applied Mechanics, University of Illinois; Richard L. Humphrey, Consulting Engineer.

WANT TO SEE . . .

Guys and Dolls
The King and I
Top Banana
Call Me Madam?

WANT TO WIN

A holiday for two in New York with all expenses paid for transportation, hotel, sight-seeing and tickets for any two of the above hit shows?

ITS EASY!

All you have to do is help us promote the 50th Anniversary Meeting of ASTM, June 23–27, 1952, at the Hotel Statler in New York City by submitting:

1. A slogan
2. Art Work for a Symbol

WHO IS ELIGIBLE?

If you are an individual member or an employee of a company or sustaining member—you are eligible to participate in this contest. Your slogan should be as short as possible (10 words or less) and the sketch for a symbol should be simple, clear and easily understood. The art work may be a rough sketch which your Publicity Committee will put in final form. Remember, ASTM stands for two things—Research through the promotion of knowledge—and Standards. Your slogan may, in addition, emphasize the 50th Anniversary Meeting.

CLOSING DATE

Contest closes February 20, 1952. No entries postmarked after this will be accepted. The Publicity Committee will act as judges. The right is reserved to reject any or all entries—the decision of the judges is final. The accepted slogan and symbol remain the sole property of ASTM.

LET'S GO!

Now is the time for all you good folks in the advertising and engineering departments to come to the aid of the ASTM—and win for yourself a grand, glorious and free three (3)-day holiday for two in New York. Any New York winner may choose Atlantic City, New Jersey, or Washington, D. C. ACT NOW! Send your suggested slogan and symbol to ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pennsylvania.

Ephraim Freedman, Chairman
Promotion and Publicity Committee
ASTM 50th Anniversary Meeting

DISTRICT ACTIVITIES

Los Angeles Meeting Draws Over 500 to Hear F. L. LaQue

Southern California District Reports Record Crowd at Joint Meeting

THE combination of an outstanding speaker, who had made a special trip to the West Coast to speak at Northern and Southern California ASTM meetings, the joint cooperation of several of the engineering societies, and intensive work on the part of the ASTM District Council, resulted in one of the finest district meetings yet held anywhere. This was the meeting held in Los Angeles on November 8, 1951.

F. L. LaQue, The International Nickel Co., Inc., New York, widely known authority on corrosion testing and engineering, who had delivered the 1951 ASTM Marburg Lecture on the subject, was the speaker, and in the words of District Chairman Carroll M. Wakeman, "he performed with the smooth, easy, fashion of one who knew his topic thoroughly, and transmitted his interesting information in such a way that it was useful, instructive, and enjoyable to everyone present."

Preceding the technical meeting, which was held in the Rodger Young Auditorium, there was a social hour, followed by a dinner. The accompanying photographs show some of the ASTM Councilors and Officers of other groups who were present, and the group photograph gives some idea of the capacity audience.

Since the Marburg Lecture by Mr. LaQue is now available, and because he selected certain topics from that, no attempt is made here to cover his Southern California remarks.

Part of the record breaking group that attended the Southern California District meeting held in Los Angeles in conjunction with several other technical and engineering societies.

A number of the ASTM councilors cooperated in phases of the meeting, including John Delmonte, who was concerned with display of literature and promotion, but the intensive spade work from the planning stage right through was largely the responsibility of the Chairman, Carroll M. Wakeman, Los Angeles Harbor Dept., and the Secretary, Myron B. Niesley, President, California Testing Laboratories, Inc.

A list of the cooperating societies included the following:

American Society for Metals
American Society of Civil Engineers
American Society of Electrical Engineers
American Institute of Chemical Engineers
American Society of Mechanical Engineers
National Association of Corrosion Engineers
American Institute of Mining and Metallurgical Engineers

Another feature that made the meeting so successful was the fact that it was part of a 2-day meeting which had been arranged by the local group of the National Association of Corrosion Engineers.

At the speakers' table, Southern California District Meeting, left to right: Milton Zim. R. B. Stringfield, E. O. Slater, E. O. Bergman, W. C. Hanna, L. Jack Taylor, Leo Schapiro, George R. Lake, Will m Nash, Kenneth Clark.

Future District Meetings

Philadelphia—Pittsburgh—New York—Cleveland—Milwaukee

THE following brief notes will post our members on some of the projected meetings to be sponsored by the respective districts. As customary, a direct-mail notice will be sent to the members and committee members in these respective areas.

Philadelphia—February 5, 1952—"Synthetic Fibers"—Philadelphia Textile Institute

The featured technical speaker at a meeting which has been in the planning stage for some time at the Philadelphia Textile Inst., School House Lane and Henry Ave., will be Dr. John H. Dillon, Director, Textile Research Inst., Princeton, N. J. Dr. Dillon will cover the newer synthetic fibers, relating them to future applications and their impact in various fields. His talk is not specifically for textile technologist, but for the average materials man, whether he be a metallurgist, chemist, or whoever!

Preceding this talk scheduled for 8: P.M., Bertrand W. Hayward, Director, Philadelphia Textile Inst., will give a brief address at the dinner to be held at the school at 6:30 p.m. Earlier in the afternoon, the institute is having open house, when ASTM members and others interested will be welcome to inspect the excellent facilities of this fine new institution. Dinner reservations should be made in advance through ASTM headquarters.

New York City—February 29, 1952—"Corrosion—Its Effect on Machine Designing"—Engineering Societies Building

The New York District is sponsoring, jointly with the Machine Design Division of The American Society of Mechanical Engineers, Metropolitan Section, and the American Society of Lubricating Engineers, New York Section, a technical meeting at which F. L. LaQue, In Charge of Corrosion Engineering Section, Development and Research Division, The International Nickel Co., will speak on the intriguing topic of "Corrosion—Its Effect on Machine Designing." Mr. LaQue, one of the world's foremost authorities on corrosion, and 1951 ASTM Marburg Lecturer, will cover the causes and prevention of corrosion, corrosion of certain metals in different atmospheres, the results of corrosion testing and research, materials to combat corrosion, and the use of such materials in machine design. We are sure that every engineer, no matter what his interest or specialization, will find this address of exceptional interest.

Pittsburgh—March 3, 1952—"The Manufacture and Applications of Boron Steels"—Mellon Institute

At a meeting which the Pittsburgh District is sponsoring jointly with the American Institute of Mining and Metallurgical Engineers, Mr. Porter R. Wray, Metallurgical Engineer, Carnegie Illinois Steel Co., will discuss "The Manufacture and Applications of Boron Steels." This is a very live subject at the moment, since boron steels contain some ray of hope for the many users of alloy steel who may be forced to forego many of the materials they have been using, because of the stringency of alloy materials. Mr. Wray has been very active in various groups concerned with boron steels, and will present an authoritative, yet down-to-earth discussion.

Cleveland District—March 5, 1952—President's Reception and Dinner—Hotel Statler

The Cleveland District is acting as host during the Spring Meeting of the Society on Wednesday, March 5. President Truman S. Fuller is to be the guest of honor at the cocktail reception and dinner at the Hotel Statler, following the symposium on "Metal Powders" being held in the afternoon. Following dinner, the President will give his address on "Solving Problems in Materials."

Chicago District—March 12, 1952—"Solving Problems in Materials"—Engineers' Society of Milwaukee

Jointly with the Milwaukee Section of The American Society of Mechanical Engineers, the Chicago District is sponsoring a technical meeting—the first ASTM technical meeting in Milwaukee, which will feature ASTM President Truman S. Fuller's address, "Solving Problems in Materials." Harry G. Miller, Mechanical Engineer, Chicago, Milwaukee, St. Paul, and Pacific Railroad Co., Milwaukee, Wis., member of the Board of Directors, is serving for ASTM in arranging this meeting.

Fall Meeting of ASTM St. Louis District

AT THE joint meeting of the ASTM St. Louis District and local chapter of American Society for Metals on November 1, 1951, at the Engineers' Club, there were about 185 present to hear Dr. Albert E. White, Past-President of both ASTM and ASM, give an address on "High Temperature Metals." For many years Director of the Department of Engineering Research, University of Michigan, and Professor of Metallurgical Engineering, Dr. White has devoted much of his attention to the use of both ferrous and non-ferrous metals at elevated temperatures in power stations, and numerous other applications. As Chairman of Subcommittee XXII in Committee A-1, he has directed the development of important specifications for valves, fittings, piping, and flanges for high and low temperature service.

In his talk, which followed the lines of a similar address at Detroit earlier in the year, Dr. White discussed some of the problems, how metallurgists are handling them, and worked in the background of some of the historical developments in the field.

The ASTM District Officers, S. B. Roberts, Robert W. Hunt Co., *Chairman*, and W. C. Magruder, Carter Carburetor Co., *Secretary*, handled all arrangements for the meeting, as well as the dinner for Dr. White and the St. Louis District Council.

The speakers' table, ASTM Los Angeles meeting, left to right: Bert Folda, Guy Garfield, L. M. Wilson, John Delmonte, Ben Morey, W. M. Schilling, L. L. Whiteneck, F. L. LaQue, C. M. Wakeman, Chairman, Southern California District. Insert, right: M. B. Niesley, District Secretary.

Some Unsolved Problems

Committees Submit Interesting Problems, What We Know, and What We'd Like to Know

It is an interesting fact, many times repeated, that in establishing ASTM the wise engineers of that day specifically stated first in our purposes "The promotion of knowledge of the materials of engineering," and they followed this with the reference "and the standardization of specifications and the methods of testing." To those who work on technical committees, it is not news that frequently interminable hours of fact-finding and research work must precede setting down any purchase requirements, and very frequently, intensive research must precede even the development of a proposed standard test method.

Past-President F. O. Clements, was very fond of emphasizing that "research and standardization go hand in hand." It is unquestioned that ASTM standards are competent because, as A. C. Fieldner also a Past-President has stated, they are based on the best commercial practice, on scientific research, and on sound engineering judgment.

Past-President F. Malcolm Farmer stated that "Certainly one of the aims in promoting knowledge of materials is to increase the efficiency and effectiveness of these materials."

However, the Society does not carry out its extensive research work, which has been so splendidly supported down through the years by industry and government, solely from the standpoint of supporting standards. Much basic information has come from our research work, and the hundreds of technical papers, special technical publications, the *Proceedings*, and such books attest the important place which research occupies in ASTM.

ASTM Research Reviewed

One of the most comprehensive summaries of ASTM research activities was published in the December, 1943 BULLETIN. More than 150 projects were cited representing many phases of the research problem: Collection and correlation of existing data in certain fields and subsequent publication; development of a precise method of testing involving instrumentation problems; long-time corrosion tests. One factor which has resulted in such a wealth of research data coming from the Society is the close cooperation evidenced in so many of the committee research programs through the large number of round-robin and cooperative tests which form the basis of many of the activities.

In the May, 1947 BULLETIN, a similar article appeared summarizing previous projects and including the new work initiated between 1943 and 1947.

Current Problems

About two years ago the Administrative Committee on Research requested the various technical committees to submit current research problems in their respective committees. These statements were reviewed by the Administrative Committee on Research and it was decided that such problems should be published in the BULLETIN and subsequently distributed in reprint form or in the form of a pamphlet to various engineering and science schools and to research institutes and testing laboratories as a suggested basis for possible research work.

Five of these problems are included in this issue of the BULLETIN and additional problems will appear in subsequent issues.

The research problems in this article cover:

Durability of Concrete
Constitution of Lignin
Test for Rapid Appraisal of Weatherability of Asphalts
The Effect of Various Factors on the Fatigue Life of Materials
Fatigue Strength of Metals Subjected to Combined Stresses

The Durability of Concrete

Statement of Unsolved Problem Contributed by Committee C-9 on Concrete and Concrete Aggregates

Problem:

Portland cement concrete is the most commonly used structural material where known strength and adequate resistance to the disintegrating forces of natural exposure are important factors. The present state of knowledge enables the engineer adequately to design for strength. It does not make full provision for designing for adequate durability where severe weathering exposure is encountered.

Present State of Knowledge:

The weathering failure of concrete is generally considered to consist of two major types of deterioration, and combination of these disintegrating factors:

1. Failure in resistance to freezing and thawing, wetting and drying, and associated temperature changes, conditions ordinarily encountered in temperate climates.
2. Failure due to chemical reaction between the cement and certain aggregates frequently used in concrete construction. This reaction is frequently referred to as alkali aggregate reaction.

The chemical composition of the cement has not been shown to have any significant relationship to the resistance which concrete offers to ordinary weathering action.

The inclusion of 4 to 6 per cent, by volume, of air in concrete has been found to increase substantially the resistance to freezing and thawing.

High alkali cements (0.80 per cent or more) have been found to be very likely to cause adverse chemical reaction between the cement and certain aggregates, particularly aggregates containing opal, and certain volcanic glasses. There is reason to believe that other characteristics of the cement also effect this reaction or produce similar reactions.

Questions That Need to Be Answered:

1. What is the mechanism which causes the failure of portland cement concrete under normal outdoor exposure to weathering action?
2. What characteristics of the cement and aggregate, physical and chemical, affect resistance to weathering?
3. What are the effects of construction practices, handling, placing finishing and curing, upon concrete durability?
4. What are the chemical and physical reactions which cause concrete failure with certain cement aggregate combinations?

Present tests for all types of durability are inadequate, and much needed work must be done to develop significant tests to measure these properties.

Additional information may be obtained from A. T. Goldbeck, 1415 Elliot Place, N. W., Washington 7, D. C.

Constitution of Lignin

Statement of Unsolved Problem Contributed by Committee D-7 on Wood

Problem:

To determine the constitution of lignin in its native and various isolated forms.

Present State of Knowledge:

Although information on the chemical reactions and nature of lignin is gradually being accumulated, we still lack any exact knowledge as to its constitution.

Questions That Need to Be Answered:

We need to know the exact constitution of lignin isolated by different methods from various woods and annual plants to determine differences in lignin from various sources and the changes that occur during various isolation methods as an aid to lignin utilization.

Introductory References:

(1) L. E. Wise, "Wood Chemistry," Reinhold Publishing Co., New York (1944).

(2) Friedrich E. Brauns, "Chemistry of Lignin", Academic Press, New York, N. Y. (1951).

Additional information may be obtained from L. J. Markwardt, U. S. Forest Products Laboratory, Madison 5, Wis.

Test for Rapid Appraisal of Weatherability of Asphalts

Statement of Unsolved Problem Contributed by Committee D-8 on Bituminous Waterproofing and Roofing Materials

Problem:

The durability of various asphalts when exposed to the weather ranges over a wide scale of values. For many uses, weatherability of high degree is of primary importance. Accelerated durability tests thus far devised, although admittedly more rapid than actual weather exposure, are quite lengthy and time-consuming. There is need for a method or methods which, within a matter of hours or at most a few days, would yield a significant index of relative durability under actual weather exposure.

Present State of Knowledge:

Much work has been done using various sources of radiant energy coupled with moisture and thermal shock and, in most cases, using films of conventional thickness. Results, however, require continuous cycling for relatively long periods of time usually extending over several weeks. Some work has been done to relate composition with durability but no well-defined relationship between composition and relative durability has yet been developed.

Questions That Need to Be Answered:

1. What factor or factors involved in natural weathering are most destructive to asphalts, that is, cause them to fail most rapidly?
2. How can these factors be accelerated and controlled so as to produce destructive effects that can be measured and rated within a few hours or at most a few days?
3. Can a relative durability rating be developed by extending the knowledge of chemical and physical makeup of asphalts?
4. Is weatherability materially affected by the presence of relatively small amounts of components, organic or inorganic, not included in the customary category of asphaltenes, resins, and oils?

Introductory References:

(1) O. G. Strieter, "Accelerated Tests of Asphalts," *RP 197*, Nat. Bur. Standards, August, 1930.

(2) Bruce Weetman, "Accelerated Weathering of Bituminous Materials—Effect of Operating Variables," *Proceedings*, Am. Soc. Testing Mats; vol. 43, p. 1154 (1943).

(3) Herbert Abraham, Asphalt and Allied Substances, pp. 1479–1509.

(4) R. R. Thurston, "The Constituents of Asphaltic Materials *Versus* Accelerated Weathering," *Proceedings*, Am. Soc. Testing Mats; Vol. 37, Part II, p. 569 (1937); Discussion, p. 573.

(5) Joseph Zapata, "Laboratory Accelerated Weathering Tests," *Proceedings*, Assn. Asphalt Paving Technologists, pp. 154–175 (1947).

(6) O. G. Strieter and H. R. Snoke, "A Modified Accelerated Weathering Test for Asphalts and Other Materials," *RP 886*, Nat. Bur. Standards, May, 1936.

(7) Joseph Zapata and C. W. Jameson, "A Study in Asphalt Shortening the Time Factor in an Accelerated Weathering Test," June 15, 1946.

(8) T. E. Stanton, and F. N. Hveen, "Test Methods for Performing Accelerated Durability Tests on Asphalts," Symposium on Accelerated Testing of Bituminous Materials, p. 84, Am. Soc. Testing Mats. (1949). (Symposium issued as separate publication, *STP No. 94.*)

Additional information may be obtained from G. W. Clarvo, Asphalt Chemist, Johns-Manville Research Center, Manville, N. J.

Fatigue Strengths of Metals Subjected to Combined Stresses

Statement of Unsolved Problem Contributed by Committee E-9 on Fatigue

Problem:

Many machine and structural parts are subjected to combined stresses rather than simple stresses acting in one direction. Although some test results are available that give the influence of some biaxial stress conditions on the fatigue strength, there is need for further study of this problem.

Present State of Knowledge:

There is some information on fatigue strengths of metals subjected to biaxial tension-tension and biaxial tension-compression stresses. These data are for either completely reversed stresses or for fluctuating stresses with a minimum value of zero. Furthermore, relatively few materials have been studied and few tests made for those stress combinations that have been studied.

Questions That Need to Be Answered:

1. What theory best agrees with the test results for biaxial tension-tension and biaxial tension-compression stresses?
2. What is the influence of the range of stress on the combined fatigue strengths in Question 1?
3. What is the behavior of the material under fatigue biaxial compressive stresses?
4. What fatigue strengths can be expected under various types of triaxial stresses?

Introductory References:

(1) H. J. Gough and H. V. Pollard, "Strength of Metals Under Combined Alternating Stresses," *Proceedings*, Inst. Mechanical Engrs., London, Vol. 131 (1935); see also Gough "Engineering Steels Under Combined Cyclic and State Stresses" *Jour. Appld. Mech.* vol. 18, June, 1951, p. 211.

(2) J. Marin, "Strength of Steel Subjected to Biaxial Fatigue Stresses," *Welding Journal*, Research Supplement vol. 21, November, 1942, p.554-s.

(3) G. K. Morikawa and LeVan Griffis, "The Biaxial Fatigue Strength of Low Carbon Steels," *Welding Journal*, Research Supplement vol. 24, March, 1945, p. 167-s.

(4) H. Majors, B. D. Mills, and C. W. MacGregor, "Fatigue Under Combined Pulsating Stresses," *Transactions*, Am. Soc. Mechanical Engrs., Vol. 71 (1949), p. 269.

(5) J. Marin, "Biaxial Tension-Tension Fatigue Strengths of Metals," *Transactions*, Am. Soc. Mechanical Engrs., Vol. 71, p. 383 (1949); see also *Tech. Note 1889*, Nat. Adv. Committee Aeronautics May, 1949.

Additional information may be obtained from T. J. Dolan, Talbot Laboratory, University of Illinois, Urbana, Ill.

The Effect of Various Factors on the Fatigue Life of Materials

Statement of Unsolved Problem Contributed by Committee E-9 on Fatigue

Problem:

Because of the present great interest in fatigue life as well as the fatigue limit, it would be desirable to make a systematic study of the various factors that may affect fatigue life. These would include surface finish, surface treatment, frequency of repetition, overstressing, understressing, coaxing, etc.

Since scatter of results is always present in fatigue life tests, it would be especially desirable to determine whether certain factors induce less scatter than others.

Present State of Knowledge:

Some of the factors mentioned above have been encountered in studying the relation between stress history and fatigue damage. In the past, various factors that influence fatigue limit have been studied, and it now seems desirable to know also what their effect is on fatigue life.

Questions That Need to Be Answered:

1. When fatigue life tests are made on several different machines of the same type, are the results directly comparable or must one suspect a machine factor?
2. When fatigue life tests are made on machines of different types, are the results comparable?
3. What are the causes of scatter in fatigue life tests?
4. Is it possible to use a surface finish which will hold scatter to a minimum?
5. Is scatter of results partly due to the fact that we have no precise criterion of what constitutes fatigue failure?

Introductory References:

(1) Battelle Memorial Inst., "Prevention of Failure of Metals Under Repeated Stress," John Wiley and Sons, New York (1941).

(2) ASTM Research Committee on Fatigue of Metals, "The Effect of Type of Testing Machine on Fatigue Test Results," *Proceedings*, Am. Soc. Testing Mats., Vol. 41, pp. 133–153 (1941).

(3) J. B. Kommers, "The Effect of Overstress in Fatigue on the Endurance Life of Steel," *Proceedings*, Am. Soc. Testing Mats., Vol. 45, pp. 532–543 (1945).

Additional information may be obtained from T. J. Dolan, Talbot Laboratory, University of Illinois, Urbana, Ill.

Excerpts from Papers at Standardization Conference

THE December ASTM BULLETIN, pages 11 to 14, included the news account with excerpts and abstracts of some of the papers given at the Second National Standardization Conference during the 1951 ASA Annual Meeting. This material included abstracts of papers in the session on standards for purchasing and how to use them, and a reprint of the paper "Putting Standards Into Action" by J. H. Foote.

There were of course many other significant papers presented at the conference not referred to in our news account. Following are excerpts from several of these which may be of interest to a number of our members.

Keynote

IN DELIVERING the keynote address, Mr. D. A. Hulcy, President, Lone Star Gas Co., Dallas, Texas, and also President, Chamber of Commerce of the U. S., gave what he called five standards for action by the business community in leadership toward a brighter, more prosperous, more secure America. These "standards" are as follows:

"*First*, business was never in a more favorable position to speak with the voice of leadership, and it was never in a more favorable position to be heard. World War II taught all Americans that their ultimate safety from alien aggression is the productive might of the American economic machine.

"*Second*, the colossal flops of socialistic experiments abroad are common knowledge in America. This is something for American capitalism to capitalize upon. No propaganda tricks are needed. A simple recitation of the bold facts is enough.

"*Third*, let us emphasize that what hurts business in America hurts America. In years gone by, we have taken the approach that what is good for business is good for the country. That is all true, but the reverse is truer.

"*Fourth*, let us get off whatever high horses we may have been riding and talk in everyday language about our problems and about what we really do for a living.

"*Fifth*, let us burnish our own armor of morality. Morality always takes a little holiday in the wake of a war, so business must exert a moral leadership if it expects to lead. The public is well-wrought up about the influence peddlers in government. But I maintain it is just as culpable to buy influence as it is to sell it. This is one time when business must be like Caesar's wife, above reproach."

Railway Research Promotes Standardization

MR. Gerald M. Magee, Research Engineer, Association of American Railroads, described the organization and activities of the Association and its vital function of establishing and coordinating methods and materials for railway operations and maintenance of U. S. railroads. Stressing the importance of research in this effort, he said, " . . . research offers some of the most effective tools for accomplishing standardization. Differences in design and specifications are largely the result of an inadequate understanding of the functions of a given design or the requirements for a given material. Well-planned and comprehensive research will serve to bring all the facts to light so that divergence of views will be crystallized into one acceptable design or specification."

As an illustration of this, Mr. Magee cited the time when as many as twelve different rail sections of the same weight per yard were made at great expense to the mills and delay in filling orders. As a result of research by the Association using modern electric strain measuring equipment a minimum number of rail sections has been accepted which meet the requirements of all the railways.

Cooperative efforts of the AAR and other interested organizations such as the American Iron and Steel Inst. and the Manganese Track Society in research aimed toward standardization has yielded valuable results. As an example of this Mr. Magee described the research on the transverse fissure problem which led to control cooled treatment of rails. As a result, since 1937 all rails rolled for use in this country have been control cooled and no true transverse fissures have developed in more than fifteen million tons now in use.

The National Electrical Code

A BRIEF history of the National Electrical Code was provided by Mr. Alvah Small, former vice-chairman of the Underwriters' Laboratories, during the session, "Standards That Affect You and Me." Mr. Small pointed out that the first "insurance rules" were compiled and published by the New York Board of Fire Underwriters. They directed the safeguarding of wiring and equipment installed to utilize the energy to be supplied from the "new" Pearl St. Station of the New York Edison Co. which was opened in 1882. During the 1890's, as additional central station projects were developed over the nation, common problems of the powerhouse operator, the lineman, and the property owner and user, became recognized as such. The common treatment of a problem of the new electrical industry was under the auspices of the National Electric Light Assoc., NELA, as it came to be known.

During that decade, the fire insurance business was necessarily developing safeguarding rules to be observed by installers of electrical equipment. These rules had followed much the same course in their development and in 1897 were the occasion for the appearance of the first edition of the National Electrical Code published thereafter by the National Board of Fire Underwriters.

From 1897 to 1923, recognition of the code grew largely because of its own merit, as well as the joint interest of its sponsorship, of property owners, and of those more directly sharing the rewards of public acceptance of electricity. It may well be said that for 25 years, and because of its provisions for biennial revisions, the machinery for making the code was proved competent and its product to be "filling the bill."

By reviewing the pages of the successive editions of the National Electrical Code, one can readily trace the development of the application of electrical energy to the relief of man's burdens.

The Role of Administrative Standards in Business and Industry

DEFINING an administrative standard, L. M. Dalcher, Superintendent of Standards and Publications, Fairbanks, Morse & Co., said, " . . . an administrative standard is a standard that outlines a practice, procedure, or policy to be followed by one or more units of an organization."

Describing the various manuals issued to supervisors on safety, personnel, materials, handling, etc., each with its own coding, indexing, and editorial procedures, Mr. Dalcher said that his company decided to "standardize on standards" and bring all policies and rules into one standard system as administrative standards. Their value lies in the coordination of efforts of separate groups working on different phases of the same problem, the promotion of consistency in the handling of repeated functions, the conversion of solved problems into routine procedures that make both a record and a future guide.

The question of what should be issued as a standard is resolved by use of several criteria, such as duration of interest or effectiveness, number of persons affected, etc. Preparation of the stand-

ard then becomes a cooperative procedure involving all interested divisions.

His company's experience that better over-all results are obtained through use of administrative standards, Mr. Dalcher attributed to the fact that they have more permanence; they are better conceived and written; they resolve procedural problems that overlap divisions; and stimulate the use of all standards.

International Standardization of Oil-Field Equipment

INTERNATIONAL standardization of oil-field equipment was the subject of a talk by Mr. C. A. Young, Director of the American Petroleum Institute Division of Production. Mr. Young pointed out the international nature of API standards and described briefly the factors in the growth of the petroleum industry leading to the use of American methods in foreign nations. Particular emphasis was given to the API program covering standardization of quality and interchangeability of threaded products. Pipe, in the form of casting, tubing, and drill pipe is a very vital item in drilling for oil and gas.

These tubular products are threaded with a 60-deg V-thread, both roots and crests being round. The threaded connections on accessory equipment in the drill stem, such as tool-joints, drill collars, and tool bits, utilize a coarse pitch, steeply tapered thread having a truncated 60-deg thread form. In order to solve the interchangeability problems on these units, API has set up complete specifications on a selected list of sizes of threads including master gages. The key to maintaining interchangeability on drilling tools is the maintenance of accuracy of reference master gages owned by the various manufacturers. A set of grand master drilling tool gages is deposited with the National Bureau of Standards with supplementary secondary masters deposited with official testing agencies in the Eastern, Mid-Continent, and Pacific Coast regions where manufacturers can test their master gages at stated intervals. Experience has shown that the interval of three years now specified for retesting insures complete protection for maintaining the standards.

The problem of standardization of foreign products was solved through the appointment of foreign official certifying agencies—counterparts in their countries of our National Bureau of Standards. Before appointment, the foreign testing agency was required to calibrate a gage and report on its accuracy. The gage was then sent to the Bureau of Standards where it was again calibrated and the results of these two tests then compared. Where differences occurred, they were adjusted by correspondence until there was complete agreement on the accuracy of the equipment and methods of measurement used by both.

Mr. Young stated that the value of the products made annually to API production standards is in the order of $500,000,000, not taking into account material manufactured and distributed abroad. The fact that the component parts of a drilling rig can be purchased from manufacturers residing in 13 foreign countries and assembled for drilling at some distant point is a practical demonstration of its efficacy.

Procedure for Developing Government Standards Modified

THE membership of the Society will be interested in an arrangement that has been effected with respect to the development of Government standards, both military and civilian.

This area of understanding between General Services Administration, the Department of Defense, and the Bureau of the Budget, provides that military and civilian procurement operations will be closely coordinated with respect to the technical functions of developing standard purchase specifications and their use, packaging standards, inspection policies, and others.

Under the agreement the Munitions Board Standards Agency is designated to represent the military and GSA's Federal Supply Service will represent all civilian agencies.

Major specific points of the agreement include:

1. Cooperative development of Federal Specifications covering common items of supply in Government and their mandatory use by all agencies, military and civilian, wherever practicable, after a one-year trial period, during which they would be known as Interim Specifications and optional for use.

2. The coordinated development through the Munition Board's Standards Agency of military specifications covering items required for national defense which would be mandatory for use by all military agencies after a trial period during which they would be known as Interim Military Specifications and optional for use.

3. Elimination of duplicate or nearly identical specifications so that a single document can be used.

4. Greater utilization of nationally recognized industry and technical society standards and specifications "to the maximum extent" with corresponding reduction in the development of specifications for items where the volume of procurement is not sufficient to warrant the expense and effort of preparing a specification.

5. Coordination in the problem of developing uniform standard quantity packs for items frequently handled, and of providing standard packaging requirements to meet the varying needs for both domestic and export shipments.

6. Maximum utilization of existing inspection and test facilities and agreements to develop inspection policies and procedures mutually, including inspection manuals and training methods.

The agreement, in effect, narrows the gap between what is purely a military item and a civilian item, and brings the resources of all parties to bear upon the problem of handling singly the work connected with supplying those needs which all agencies use. The agreement also initiates for the first time a concerted effort between the military and civilian agencies to standardize the items which are used in common by the Federal Government.

A supplemental agreement has also been signed between the Department of Defense and GSA defining specific tasks and outlining methods under which the cooperative program is to work.

A Greeting

WE LIKE the sentiment embodied in the Christmas card from our New York consulting friend and member:

"The same vision, faith, and courage that stabilize our way of life, happily keeps alive the good old custom of remembering friends at this time of year. May your Christmas be joyous and your New Year happy and prosperous."

Conservation of Nickel

By George R. Gohn[1]

ASTM Committee B-5 on Copper and Copper Alloys suggests that nickel can be conserved by using 12 per cent nickel silver sheet and strip in place of the 18 per cent alloy in the manufacture of small flat springs. This proposal was originally made during World War II by Mr. J. P. Guerard and Mr. G. R. Gohn, the representatives of the Bell Telephone Laboratories, Inc., on this standing committee. A task group consisting of representatives of the American Brass Co., the Revere Copper and Brass Inc., the Riverside Metal Co., the Seymour Manufacturing Co., the Bell Telephone Laboratories, Inc., and the General Electric Co., investigated this proposal and in 1946 recommended that ASTM Specifications B122 be revised to include a 12 per cent nickel silver alloy suitable for use in the manufacture of flat springs. This alloy, designated as Alloy No. 8, has a nominal composition of 56.5 per cent copper, 12 per cent nickel, and 31.5 per cent zinc. The tensile strength and Rockwell hardness values of this alloy as contrasted to those of the 18 per cent nickel silver alloy are given in Table I.

Additional data on some of the useful engineering properties of these two alloys are given in Table II. This information was supplied to the task group by the Bell Telephone Laboratories, Inc.

[1] Technical Staff, Bell Telephone Laboratories, New York, N. Y.

TABLE I.—TENSILE STRENGTH REQUIREMENTS OF ROLLED PLATE, SHEET AND STRIP COPPER-NICKEL-ZINC.

Temper	Tensile Strength, psi.		Rockwell Hardness[a] (Values Included as Information Only)					
			G Scale		B Scale		Superficial 30-T	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Alloy No. 4 (55 Cu, 18 Ni, 27 Zn)								
Quarter hard	69 000	87 000	23	62	70	88	63	75
Half hard	78 000	95 000	51	69	81	92	71	78
Hard	92 000	107 000	67	76	90	96	76	80
Extra hard	102 000	115 000	73	80	95	99	79	82
Spring	108 000	120 000	77	83	97	100	80	..
Alloy No 8 (56.5 Cu, 12 Ni, 31.5 Zn)								
Quarter hard	65 000	81 000	..	..	61	85	57	74
Half hard	75 000	91 000	..	..	78	91	69	77
Hard	90 000	105 000	..	..	90	95	76	79
Extra hard	101 000	114 000	..	..	94	98	79	81
Spring	109 000	122 000	..	..	97	100	80	..

[a] Rockwell hardness values are given in this table only as information and are significant to the nearest number. They apply as follows to rolled plate, sheet, and strip: The B and G scale hardness values apply to metal 0.020 in. and over in thickness, and the 30-T scale hardness values apply to metal 0.012 in. and over in thickness.

TABLE II—MECHANICAL PROPERTIES OF TWO COPPER-NICKEL-ZINC ALLOY (NICKEL-SILVER) SPRING MATERIALS (STRIP).
(Stress Values in psi)

Material	Temper	Grain, Direction, deg.	Rockwell Hardness	Proportional Limit	Yield Strengths, per cent			Fatigue Limit at 10^8 Cycles of Reversed Stress	Tensile Strength	Elongation per cent in 2 in.	Young's Modulus
					0.01 Set	0.2 Set	0.5 Elong.				
Alloy No. 4 Nickel Silver Strip per ASTM B 122–50 T (18 per cent Ni)	(Soft)	0	B49	..	19 200	26 000	26 800	16 000	62 900	45.0	19.6×10^6
		45	B49	17 500	21 700	25 800	26 400	..	61 700	47.0	19.4
		90	B49	17 500	22 400	26 100	27 200	..	62 200	47.0	20.7
	(Hard)	0	B92	43 600	63 700	100 400	89 100	21 500	101 500	1.0	20.4
		45	B92	41 800	59 000	88 600	76 700	..	97 600	2.5	17.6
		90	B92	48 300	60 700	92 200	83 700	..	101 400	2.3	20.6
	(Extra-Hard)	0	B93	42 900	60 200	100 200	90 800	21 000	104 800	1.5	21.2
		45	B93	44 700	58 000	89 900	78 000	..	98 300	2.2	18.1
	(Spring)	0	B98	47 300	68 000	..	94 900	23 500	110 300	1.5	21.5
		45	B98	48 600	65 900	100 400	83 700	..	109 200	2.0	18.8
		90	B98	57 800	71 400	107 300	93 300	..	115 600	2.0	21.5
Alloy No. 8 Nickel Silver Strip per ASTM B 122–50 T (12 per cent Ni)	(Soft)	0	B46	16 600	19 900	..	..	..	62 400	59	16.3
		45	B46	17 800	21 500	..	..	..	60 800	65	16.5
		90	B46	17 800	22 300	..	..	..	60 200	62	18.1
	(¼ Hard)	0	B74	33 200	42 300	57 400	56 900	..	70 200	26.8	18.2
		45	B73	29 400	35 200	49 800	49 900	..	65 100	34.3	17.2
		90	B72	29 300	34 700	50 900	51 100	..	66 500	32.7	18.3
	(Hard)	0	B91	36 300	56 000	..	..	..	96 100	2.2	19.6
		45	B91	46 200	54 500	..	..	..	90 200	6.2	15.9
		90	B91	46 900	57 400	..	..	..	93 000	5.4	18.9
	(Extra-Hard)	0	B93	53 800	71 100	105 600	84 300	23 000	107 600	2.0	18.2
		45	B92	50 100	60 200	93 000	73 900	..	102 600	3.0	16.3
		90	B92	51 300	63 900	96 500	82 200	..	107 400	3.0	18.9
	(Spring)	0	B96	57 100	72 400	110 400	81 300	..	113 200	2.0	18.3
		45	B96	52 600	65 100	99 200	74 500	..	110 400	2.0	16.0
		90	B96	55 100	68 000	102 100	82 700	..	114 900	2.3	18.2

Applied Spectroscopy

THE Society for Applied Spectroscopy, organized for the advancement of the art and science of applied spectroscopy, publishes a quarterly journal, *Applied Spectroscopy*, devoted to the interests of the applied spectroscopist in science and industry. It carries articles of interest to emission, absorption, X-ray, Raman, and mass spectroscopists. In each issue there is an index to the literature. Announcements of meetings, symposia, and other events of interest are featured. The Society itself holds monthly meetings at the Socony-Vacuum Training Center, Park Row, New York City, from September to April, and an annual symposium in New York City in May.

Applied Spectroscopy may be obtained either *via* membership in the Society or subscription. The fee for sustaining membership in the Society for Applied Spectroscopy is $20 per year; for regular membership $5. The subscription fee is $2 per volume of four issues. The Secretary of the Society for the current year is Charles A. Jedlicka, Lucius Pitkin, Inc., 47 Fulton St., New York 7, N. Y.

Since 1949, SAS and ASTM have cooperated in sponsoring the Joint Committee on Nomenclature in Applied Spectroscopy.

TECHNICAL COMMITTEE NOTES

Changes Proposed in Gypsum Standards

THE consideration of revisions of the "Standard Methods of Testing Gypsum and Gypsum Product" (C 26) was one of the principal items of business at a meeting of Committee C-11 on Gypsum held at the National Bureau of Standards, Washington, D. C., on December 6.

Agreement was reached on the revision of the compressive strength method based on a similar method used for hydraulic cement mortars. In discussing the efficiency of fineness determinations, it was recommended that the alcohol wash method be used for determining fines below 100 mesh. The use of small-size sieves similar to those used in cement testing was also suggested, and an attempt will be made to compare the results of the present sieve used and the proposed smaller size. For this purpose, standard samples of molding and gauging plasters will be distributed to the subcommittee members. A satisfactory method for determining consistency of plaster, using lightweight aggregates, was under discussion. It was suggested that a 125-g Vicat needle be used in place of the 150-g needle. Standard samples of a prepared plaster will be distributed for the collection of data.

The problem of determining the proper proportions of plaster and lightweight aggregate in ready-mixed plasters is considered a very much needed but difficult one to solve. In discussing a change in grading of sand proposed in the Standard Specifications for Sand for Use in Plaster (C 35 – 39), the difficulty of grouping natural and manufactured sands with lightweight aggregates such as perlite and vermiculite was recognized. A special group was designated to study a possible specification for aggregate for use in gypsum plastering, with representatives being designated from each of the different sources of aggregates involved.

Two recommendations were approved relating to structural products. A proposed test method for determining water-resistance characteristics of core-treated water-repellent gypsum sheathing was approved for immediate adoption and inclusion in Standard Methods of Testing Gypsum and Gypsum Products (C 26). Statements will also be added to the Standard Specifications for Gypsum Sheathing Board (C 79) to include core-treated board. A revision of Standard Specifications for Gypsum Wallboard (C 36) was approved, providing for the inclusion of a $\frac{5}{8}$-in. board with corresponding proper strength and weight requirements.

ASTM Work on Natural Building Stones

Discussion of Philosophy of Committee Work

NATURAL building stone, one of the oldest building materials known, still presents many problems to those interested in its physical and chemical properties and their relation to service performance. The fall meeting of Committee C-18 on Natural Building Stones, held at the Administration Building of the American Institute of Architects, Washington, D. C., on November 2, disclosed many evidences of this.

Durability remains the principal property toward which test methods are being developed which will predetermine on an accelerated basis the performance of the several types of building stones. The development of a specification for roofing slate is being held in abeyance pending further tests on a series of samples from various sources, these tests to be run at the National Bureau of Standards. The same situation exists in reference to a specification for exterior marble. Extensive research is under way at the Mellon Institute under the sponsorship of the National Association of Marble Producers, and further reports will be presented to the committee at its 1952 meetings, which should provide comprehensive data on which to base a specification.

A considerable amount of data has been collected which will assist the committee in developing a specification for building granite. The difficulty of correlating physical requirements and field experience, both factors being needed in a specification, is recognized, and this has been one of the factors in the case of building granite.

A report on the research at Mellon Institute indicated that 100 specimens of weathered and freshly cut marble have been submitted to the ASTM Method of Test for Combined Effect of Temperature Cycles and Weak Salt Solutions on Natural Building Stones (C 218–48 T). It was shown that it was very difficult and almost an impossibility to correlate weathered with freshly cut specimens. There was considerable discussion on the depth of deterioration which takes place and whether a sample taken from the interior of a block was the same as a freshly cut sample. The report on nomenclature and definitions indicated that further consideration is needed on definitions pertaining to textures and finishes as well as for additional varieties of stone not covered in existing ASTM standards.

Chairman L. W. Currier's opening remarks on committee work and participation are refreshing and practical.

The problems of the building stone industry including the restrictions and limitations of one of Mother Nature's products are outlined in a very interesting and informative manner.

Partly for the information of our several new members, and partly to review, in a general way, the scope and purpose of our work, I should like to open this meeting with a few introductory remarks concerning the organization of our committee, and the present needs in the field of its activity.

To those of you who are newly with us we extend a fraternal welcome. We want you to participate seriously in the work of this committee, as well as to attend the occasional meetings. I hope you will take an active part in the work of one or more of the subcommittees. I am sure that whatever you do will be contributory, because with your backgrounds and experiences you represent special competences in the field.

We try not to make our work burdensome to anyone. However, we do consider that it is important enough to warrant some burden of responsibility on everyone. The work of the committee should be considered to be worthy of very serious interest. I do not need to remind you that standards approved by ASTM can have considerable impact on the industry and must therefore be formulated most thoughtfully so that no injustice is done either to producers or to consumers. So far as possible the standards should be based on scientific tests and on the results of special research. At the same time they must embody the important quality of being practicable and must be consistent with various factors of production and use. In the field of natural building stones, of course, one of the factors is experience gained from use of given materials through many years. The approach in formulating

specifications must be in part from the path of such experience.

We must keep in mind that building stones are products of nature's manufactories. They are used in their natural state. No control in the manufacture of the raw material is possible. Unlike steel, or cementitious materials, or paints, *et al.*, we have no control over the composition, or the structure, or the uniformity of a building stone. We can but choose selectively from whatever nature has provided. We can of course study the physical and chemical characteristics of the materials offered and try to find out how these characteristics may be evaluated and used in our process of selection. Obviously there are many properties, physical and chemical, that might be studied. How do we know which are critical to the various purposes for which stone will be used? We hope we can recognize the essential factors—those that have most critical values—and upon them base our criteria. But we need to know something about natural variations in stone.

I am speaking as a geologist—not as a quarryman or construction engineer. Presumably a geologist is a person with some detailed knowledge of how building stones occur in nature, of their structures and compositions, and—very importantly, I think—of the normal, natural variations of a rock mass in a single quarry as well as in a larger area, or district.

It is probably these variations that are most troublesome to us when we attempt to set standards and to define specifications. From the same quarry both good and poor material may be obtained, so that a test of a specimen is not a test of a true sample of a quarry. Generally an experienced quarryman can pretty well judge material from his quarry at a glance. An inspector on a Government job may not be so well equipped to judge—although some differences in quality are obvious—and hence feels the need of a quality "yardstick."

What I am trying to emphasize is that a specimen of a stone from a given quarry and used for a test cannot be a true sample of the gross material from the quarry in the same way that a sample of a batch of steel or cement is representative of that entire batch. There are variations—even though they may be slight and not obvious—in composition, texture, porosity, and other features, that may seriously influence some tests and not others. By the same token there are variations in the determined crushing strength, absorption, etc. You could probably plot variations of any of these against variations of any other and get more or less systematic results. But no single one of these comparisons would serve to give us a true measure of durability in terms of time. In granites, for example, neither crushing strength nor chemical analysis will give us a true and general measure of weathering properties, except perhaps in instances where values for strength, for example, lie well outside the usual range for stone proved sound by long use. The crushing strengths of most sound granites lie probably in the range of 18,000 to 30,000 psi—a considerable percentage range. On the other hand, although a granite with a crushing strength of only 12,000 psi would sustain a load many times greater than any load placed on it in use, the unusually low figure would lead us to study the stone for other features—physical or chemical—that might render the stone susceptible to relatively rapid disintegration under a given set of conditions.

In trying to formulate specifications (which, together with devising or accepting methods of testing, is our chief objective), I think we should realize that any single test method gives mostly comparative results and often may not be sufficient in itself to classify the stone as to durability, or suitability for a given type of structure. If such a test as applied should give results that are inconsistent with actual experience, it seems clear that the test needs to be supplemented by some other consideration. It will be most fortunate if we can harmonize the laboratory and the experimental factors.

The Subcommittee on Specifications has a real job on its hands. It will need cooperation from all of us.

As it now stands we need specifications for all major classes of natural building stones. We are making some progress, I believe, in the marble field. Our representative from the Federal Public Buildings Administration is, I believe, anixous to have something to guide him in the other fields, so far as Government buildings are concerned.

The Subcommittee on Test Procedures has, thanks to Chairman D. W. Kessler's energy and zeal, recommended various physical tests, which have been scrutinized and modified from time to time. This subcommittee is quite current in its work but may be asked to consider other kinds of tests that may be indicated as desirable after studies of specifications have been made.

The Subcommittee on Research has no funds for active research of its own, but should be ready to advise and recommend appropriate lines of research to appropriate research agencies. It can lend its advisory capacity to research in progress, and it can study research to evaluate it for purposes of Committee C-18.

The Subcommittee on Nomenclature and Definitions still needs to consider definitions for textures and finishes, and also for a few more varieties of stone. It also awaits requests for definitions on other items.

Ceramic Whiteware Committee Holds Fall Meeting

THE subjects of definitions of terms and of test methods on raw materials were discussed at some length at the 1951 Fall Meeting of Committee C-21 on Ceramic Whiteware, held at Bedford Springs, Pa. An unusually good attendance was noted, this being partially due to the meeting's being held in conjunction with the Fall Meeting of the Whiteware Division of the American Ceramic Society.

The officers of the committee have expressed great satisfaction in the accomplishment which has been made in the writing of definitions of terms covering ceramic whiteware. In the ceramic whiteware industry, the definition of terms has been a long-standing problem. In addition to 30 definitions already accepted by the Society, 21 new terms are now ready for letter ballot of the committee. Agreement has been reached between the sanitary ware, earthenware, and the floor and wall tile industries on the definitions of such terms as vitrified, semivitrified, and other degrees of vitrification.

Drafts of proposed tentative methods of test for determining modulus of rupture in bending of dry-pressed specimens, the true specific gravity of whiteware products, and the linear thermal expansion by the interferometer method were reviewed and revised by the section concerned with fundamental properties. Four proposed methods of tests on clays were referred back to the working groups for further consideration of comments and criticisms from the committee letter ballot. These methods deal with sieve analysis and water content of clays, chemical analysis of whiteware clays, sampling of clay shipments, and linear and volume shrinkage measurements of whiteware bodies.

The Subcommittee on Research plans to organize a cooperative basic study of factors affecting sub-sieve particle size determinations and the significance of values for modulus of rupture in bending as determined on various sizes and types of ceramic whiteware specimens.

D-9 on Electrical Insulating Materials Holds Three-Day Meeting

Much Standards Work Reported Underway

A NUMBER of new and revised methods were approved by Committee D-9 on Electrical Insulating Materials during a three-day meeting in Niagara Falls, Ontario, on November 14–16, held in conjunction with that of Committee D-20 on Plastics.

The fourth of a series of symposiums on Electrical Insulating Oils, sponsored by the D-9 Subcommittee IV on Liquid Insulation, included the following papers:

Evaluation of Mineral Transformer Oil During Service, Part II—A Further Correlation of Oil Characteristics After Continued Period of Service—F. M. Clark, General Electric Co.

Evaluation of Laboratory Tests as Indicators of the Service Life of Mineral Transformer Oils—T. A. McConnell, Detroit Edison Co.

Discussion of ASTM Round-Robin Test Results on Transformer J—R. G. Call, American Gas and Electric Service Corp.

This symposium will be brought out as a special publication.

A testimonial dinner was tendered to Edgar A. Snyder upon his retirement, in appreciation of his many contributions to the committee, especially his 26 years' service as Chairman of Subcommittee IV.

Revisions were completed of the Tentative Methods of Testing Askarels (D 901–50 T), involving the procedure for sampling. Work is being reactivated on a study of the steam emulsion test for insulating oils. A proposed water extraction method was authorized to go to letter ballot vote of Subcommittee IV.

A draft of new methods of test for silicone insulating varnishes was reviewed. These cover test procedures for viscosity, specific gravity, flash point, dielectric strength, drying time, draining test, and nonvolatile matter. Arrangements were completed for a round-robin testing program to study the procedures for drying time, draining test, and dielectric strength of silicone insulating varnishes. The Section on Laminating Varnishes is carrying on a cooperative study of tests from setting time looking toward the establishment of a standard method. The Sections on Oxidizing Insulating Varnishes and on Heat Reactive Varnishes are jointly investigating tests for viscosity, density, and drainage time.

Extensive revisions of the ASTM Tentative Specifications for Laminating Thermosetting Materials (D 709–49 T) have been approved by committee vote and will be presented to the Society for acceptance as tentative. These specifications will bring into agreement requirements for these materials in the Military specifications and also in those of the National Electrical Manufacturers Assn.

Revisions were completed in the Tentative Specifications for Vulcanized Fibre Sheets, Rods, and Tubes Used for Electrical Insulation (D 710–49 T); and also in the Methods of Testing Vulcanized Fibre Used for Electrical Insulation (D 619–49 T). This revision will bring these standards into agreement with those of NEMA which are also being revised. A revision was also approved in the Methods of Testing Molded Materials Used for Electrical Insulation (D 48–46 T), providing for use in the insulation resistance test of the 4-in. disk specimen.

New tentative specifications for cellulose acetate for sheet and film for primary insulation have been approved.

The Subcommittee on Solid Filling and Treating Compounds reviewed the recently issued Tentative Methods of Testing Hydrocarbons Waxes Used for Electrical Insulation (D 1168–51 T). Cooperative tests are to be conducted on the procedures for saponification number and loss on heating. A new section was appointed to develop method of testing polymerizable casting materials.

The Subcommittee on Insulating Fabrics submitted for committee vote a revision of the Methods of Testing Varnished Glass Fabrics and Varnished Glass Fabric Tapes Used in Electrical Insulation (D 902–50 T), which involves an elevated temperature test which was developed after considerable investigative work. Four subjects under active study are: (1) elongation-temperature relations of varnish cloths and tapes, (2) effect of 6 per cent elongation on dielectric strength of tapes, (3) suitable electrodes for the power factor test, and (4) specifications for oil-packed tapes.

Some of the newer materials, such as vinyl-coated glass, are being considered in connection with a revision of the Tentative Methods. The Subcommittee on Electrical Tests plans to sponsor a Panel Discussion on Insulating Resistance Measurements, to be held at the meeting of Committee D-9 in Philadelphia during the week of February 25.

A revision and extension of the Tentative Method of Test for High-Voltage, Low-Current Arc Resistance of Solid Electrical Insulating Materials (D 495–48 T) will cover (1) higher current arcs, that is, up to 100 milliamperes; (2) development of a method of providing a continuous increase in arc severity, to supplement the present step-wise procedure; and (3) the development of other forms of arc-resistance tests.

The Subcommittee on Insulating Papers reported completion of a test for bursting strength of condenser paper and also a new method of measuring the stretch under tension of creped paper. Statements on the significance of the following test for condenser papers have also been completed: alcohol-soluble matter, water-soluble matter, water-extract conductivity, and fiber analysis.

The Subcommittee on Mica has been cooperating actively with the Government in the establishment of visual standards for classification of raw mica. This activity is in connection with the Government stock piling program and has resulted in a number of important changes to be incorporated immediately in the ASTM Specifications for Natural Muscovite Mica Based on Visual Quality (D 351–49 T).

Committee D-9 has also approved a revision of Specifications for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors (D 748–49). This will extend the usefulness of Standard D 748 by the addition of a new rapid test method which is suitable for classifying the electrical quality of individual mica films used in capacitors. The newer types of pressure-sensitive adhesive tapes are also under study for inclusion in Tentative Methods D 1000.

Errata in Bolting Specifications, Part 1, 1951 Supplement

IN PRINTING the Tentative Specifications for Alloy-Steel Bolting Materials for Low Temperature Service (A 320 – 51 T) an error has occurred on p. 221 of the 1951 Supplement to Book of ASTM Standards, Part 1. The first sentence of Section 14 (*a*) should read as follows: "Bolts, studs and stud bolts of grades L7 and L10 shall be equipped with ferritic alloy nuts conforming to grade 4 of the Standard Specifications for Carbon and Alloy-Steel Nuts for Bolts for High Pressure and High Temperature Service (ASTM Designation: A 194),[3] or a grade of steel similar to the studs, or other ferritic alloys agreed upon."

This specification will appear in its correct form in the Piping Compilation (about Feb. 1) and the separate reprints distributed after January 3 will also be corrected.

D-10 on Shipping Containers Meets in Cleveland

THAT the current focal point of interest in Committee D-10 on Shipping Containers is in the development of performance standards and the correlation of data was evidenced by the large attendance of members and visitors at the subcommittee meetings dealing with these subjects. The meetings were part of the Committee D-10 fall meeting at the Hotel Statler in Cleveland, Ohio.

In the Subcommittee on Performance Standards, a discussion centered around the establishment of a performance standard on a packaged product. The pertinent point was that the container must be designed to meet the shipping hazard. A task group presented certain premises, which were discussed and accepted, to govern the work of the subcommittee in this field. For example, it was decided that shipping hazards can be analyzed by using certain tests; size and weight determine how the package will be handled; certain hazards or degrees of hazard are dependent upon the type of transportation; hazards can be simulated by certain ASTM methods, such as the drop, vibration, compression, and possibly the incline-impact test. It was felt that there should be a sequence of tests and finally performance requirements set up to determine what is allowable damage. Task groups were authorized to gather data and submit progress reports at the next meeting on various phases of the work.

In the Subcommittee on Correlation of Data a final report was submitted on the round-robin test on the revolving drum. It is the conclusion that this type of test is not suitable for correlation between laboratories but can be used in one laboratory for comparison of specimens. On this basis, no performance standards were recommended at this time dealing with the revolving drum test method. Eighteen laboratories are participating in a round-robin series on the use of the drop test. Concern was expressed over the proper base as part of the equipment for this test, it being pointed out that a very rigid type of base is required. The Subcommittee on Methods of Testing took action to adopt as standard the Tentative Methods of Testing Large Shipping Cases and Crates (D 1083–50 T). A progress report, presented on a proposed puncture test, pointed out that there was considerable difficulty involved in eliminating variables of a puncture test procedure. A program devised for the next few months involves the use of a magnetic release for dropping of a missile for a measured distance on to plies of a bag which are stretched over a material such as a mound of sand, in a 14-in. diameter pail. Data will be presented at the spring meeting of the committee.

A new proposed method for measuring moisture and water vapor resistance in the form of a cycle test for water vapor permeability of packages was discussed. Activity in the study of interior packing is at present confined to the preparation of a bibliography on the functions of cushioning materials. A report on the evaluation of material for shock absorption will be discussed further at the spring meeting.

At the close of the general meeting a talk was presented by W. M. Bertolet, Baldwin-Hamilton-Lima Corp., on the use of strain gages in container testing. Additional discussion and data on the subject were presented by C. S. Macnair of Acme Steel Co. and J. G. Turk of Preston Laboratories, prominent members of the committee. An inspection trip through the General Electric Lighting Inst. at Nela Park included a visit to the Package Testing Laboratory. The next meeting of the committee was set for March 31 and April 1 in Atlantic City.

D-20 on Plastics Holds Fall Sessions at Niagara Falls

Research Subcommittee Papers Feature Three-Day Meeting

THE three-day meeting of Committee D-20 on Plastics at Niagara Falls, Ontario, on November 12 to 14, was highlighted by a papers session sponsored by the Subcommittee on Research at which the following three technical papers were presented:

Volumetric Measurements on Polymer Melts—E. B. Cooper, E. I. duPont de Nemours & Co., Inc.

Quantitative Measurements of Internal Stresses in Molded Thermosetting Plastics—R. De Waard and T. Alfrey, Jr., American Cyanamid Co.

Long-Time Relaxation of Some Rubber-Like Polymers—I. L. Hopkins, Bell Telephone Laboratories.

The American group for Technical Committee 61 on Plastics of the International Standards Organization held a meeting on November 12, at which consideration was given to American participation in five working parties that have been established by the ISO Committee. The American group will be responsible for directing the program to be undertaken by the working party on thermal properties. The Netherlands will direct the work on mechanical properties; France on definitions; the United Kingdom on physical and chemical properties; and Sweden on conditioning and humidity.

A cooperative test program under the sponsorship of the Society of the Plastics Industry on the study of tensile compressive properties of thin plastic sheets and films has been completed. As a result of the information obtained in these studies the committee will revise the Tentative Methods of Test for Tensile Properties of Thin Plastic Sheets and Films (D 882–49 T), which was prepared jointly by the SPI and the ASTM.

The committee considered at length what types of requirements should be included in purchase specifications for plastics to serve as a basis for agreement between the buyer and seller, that is, whether a specification should include only those tests necessary to identify the particular molding compound, or whether it should contain requirements to identify or define suitability of the material for engineering or performance end uses. It was generally agreed that the content of ASTM specifications for plastics should be limited to those properties which identify (in a broad sense) and also control the uniformity of the material. It was also agreed that it would be desirable to include in specifications for plastics a qualification as to which specified properties it is recommended should be used for acceptance or rejection of the material.

The Task Group on Abrasion Resistance (optical effects) reviewed results of cooperative test data by ten laboratories on seven samples of different types of plastics, in which the results of abrasion tests were evaluated by the integrating sphere photometer. The committee also made a study of the durometer hardness of the calibrase wheels used in these tests, made in accordance with the ASTM Tentative Method of Test for Resistance of Transparent Plastics to Surface Abrasion (D 1044–49 T). Plans were made to conduct a further series of cooperative tests in the same laboratories on other samples of plastics which will include molded methacrylates.

Round-robin abrasion resistance (mechanical effects) tests are in progress on the fixed abrasive method (Armstrong) and the loose abrasive method (Olsen). Plans were made at the meeting to continue these cooperative studies.

The Subcommittee on Thermal Properties gave consideration to some final criticisms of the revised Tentative Method of Test for Brittleness Tempera-

ture of Plastics and Elastometer by Impact (D 764). The test provides for the evaluation of long-time effects such as crystallization or those that may be introduced by low-temperature incompatibility of plasticizers in the material under test. The revised method will soon be presented to the Society for approval. A new melt index test for polyethylene, which makes use of an extrusion plastometer at low rates of shear, was approved for submission to the letter ballot vote of the subcommittee as a new tentative method.

Plans were made for an immediate round-robin on the flammability test for plastic films in order to check on the reproducibility of the proposed method now in final draft form. Action was taken to submit the method to vote of the subcommittee as soon as the results of these further tests are available.

The Subcommittee on Permanence Properties submitted to Committee D-20 for letter ballot vote a new test for shrinkage of plastic film and sheeting. It also reported that a new test for resistance of plastic film to extraction by chemicals has been completed and will be voted upon in the subcommittee. A new tentative method of test for volatile loss from plastic materials has been approved by vote of Committee D-20 and will shortly be submitted to the Society. This method uses activated carbon as the immersion medium. It is a rapid empirical test which is useful in the relative comparison of materials having the same nominal thickness.

The Subcommittee on Specifications decided to undertake the preparation of specifications for modified styrene plastics and for polyester resins. A revision of the Specifications for Nonrigid Vinyl Chloride Plastics (D 744–49 T) was authorized to go to vote in the subcommittee. Progress was reported on the specification being prepared for polyethylene in which it is proposed to cover three types of materials for (1) general applications, (2) dielectric applications and (3) outdoor exposure. In all three types it is proposed to specify requirements for specific gravity, melt index. tensile strength, and upper yield stress. Requirements for brittle temperature, dissipation factor, and dielectric constant will be specified for the particular types where these properties are desirable.

New Tentative Specifications for Alkyd Molding Compounds have been approved and will be submitted to the Society. These specifications cover thermosetting molding compounds consisting of unsaturated alkyd resin binders that have been combined with fillers pigments, and other chemical agents.

The Subcommittee on Definitions completed definitions of the following terms which were authorized for subcommittee vote: saran plastics, nylon plastics, lignin plastics, halocarbon plastics, furan plastics, silicone plastics, protein plastics, polyester plastics, and resins. A revision of the Recommended Code for Designating Form of Material and Direction of Testing Plastics (D1009–49 T) was also completed.

An extensive revision of the definitions of terms and symbols relating to tension testing of plastics now appearing in Method D 638 was also approved. These definitions have been so worded that they can be applied to other materials including metals. They will accordingly be referred to Committee E-1 on Methods of Testing for establishment as a general standard.

New specifications for enclosures and servicing units for test above and below room temperature have been approved by vote of the committee for publication as tentative. These are intended to replace the existing Specifications D 760 and D 761.

Boston was selected as the site of the October, 1952, meeting of Committees D-9 and D-20.

Subcommittees of D-21 on Wax Polishes Meet at National Bureau of Standards

A SERIES of subcommittee meetings of Committee D-21 on Wax Polishes and Related Material were held at the National Bureau of Standards, Washington, D. C., on December 5 and 6. Among the activities was a review of data which have been collected to date as a result of round-robin testing in various phases of the committee work. Subcommittee I on Nomenclature has prepared drafts of definitions on such important terms as wax, wax products, and volatile solvents, which will be circulated for comment. Subcommittee II on Raw Materials reviewed results of tests at four laboratories on the determination of water and dirt, using four samples of wax. ASTM Method of Test for Water in Petroleum Products (D 95) is considered as being a satisfactory method for use with waxes. Closer reproducibility of results is felt desirable, and other round-robin test series will be inaugurated, using one sample which will be uniformly ground and separated into samples for each laboratory. Subcommittee III on Chemical and Physical Testing will continue round-robin tests to establish the feasibility of testing free alkali determination by the pH method. More data are needed to establish reproducibility of results. Data were distributed on two methods used for determining free caustic alkali, total solids, and ash content.

Performance tests are still under consideration by subcommittee IV on slip resistance, service life, and appearance. Subcommittee organization has now been effected whereby the three sections will function as separate groups operating under a steering section in order to provide the utmost efficiency in conducting separate projects.

Test data were reviewed on slip resistance tests conducted on the Sigler and Underwriters' Laboratories machines. The need was expressed for more refinement in test procedure on both machines, and a further test program was authorized, in which calibration will be accomplished on such items as the grade of sandpaper and type of heel piece used. It is also felt that some type of field method should be used to evaluate the results of the machine test methods. Plans were outlined to secure field test data based on the use of trained observers. The point was stressed that the present machines may be adequate for the purpose intended but that this type of apparatus should not be considered on a precision basis.

The Sward hardness rocker apparatus was discussed by the service life group for hardness determination. The relationship of hardness to other properties will be given consideration by the group with special task groups appointed for this purpose.

Subcommittee V on Specifications reviewed a list of properties that should be covered in a specification, as found in a survey of existing specifications. A selection was made of the properties for which the subcommittee felt test methods should be prepared preliminary to the development of actual specifications, and these will be referred to other subcommittees for development. The properties were divided into several categories, including physical and chemical properties, application, film characteristics, and service life.

A meeting of the main committee is planned for early June, 1952, in connection with the Chemical Specialties Manufacturers Association meeting in Boston.

Laboratory Apparatus Subcommittees Recommend Specifications and Tests

(Active Groups on Thermometers, Hydrometers, Metalware, Porous Filters)

At a productive series of meetings held in New York City late in November, there were sessions of the Subcommittees on Thermometers, Hydrometers, Metalware Laboratory Apparatus, and Porous Filtering Bodies, which groups function as part of Committee E-1 on "Methods of Testing."

Thermometers:

The Thermometer Subcommittee will vote by letter on several new specifications drafted for thermometers needed by other technical committees in their standards work.

Three of these are for Kinematic Viscosity thermometers graduated in Fahrenheit: (−31 to +1 F, −1 to +33 F, and +31 to +65 F). These correspond to existing thermometers in equivalent Centigrade ranges.

Three for new Aniline Point Thermometers, graduated in Fahrenheit, will cover ranges of Centigrade instruments.

A very important addition will be made to the Standard Specifications for ASTM Thermometers (E 1 – 50) providing for a metal gage to check enlargements on the position of the bulb on thermometers. This gage will simplify checking these features since measurements are rather difficult, due to the changing contours of the enlargements and bulbs. This gage was developed by E. L. Ruh, Standard Oil Development Company Laboratory, who represents Committee D-2 on the Thermometer Subcommittee. A task group will prepare specifications for a thermometer for testing jet fuels at a temperature range of 30 to 625 F.

Another ASTM thermometer to be standardized is for use in the test for oil content in paraffin wax. Laboratory tests are being made on new mercury-thallium filled thermometers for use in the ASTM low cloud and pour test. If the tests prove satisfactory, these thermometers will be approved as tentative.

Proposed standards for thermometers for use in a new test for Saybolt furol viscosity at high temperatures will be reviewed. The ranges are 245 to 265 F.; 295 to 315 F.; 345 to 365 F; 395 to 415 F; and 445 to 465 F.

A revision will be made in the ASTM Butadiene Boiling Point Thermometer 52 C, in line with agreement reached with the Rubber Reserve. The new range of −10 to +5 C, rather than the present −10 to +10 C, will permit more accurate readings.

Hydrometers:

The Subcommittee on Hydrometers reviewed a draft of new specifications for glass hydrometers of the constant-mass, variable-displacement type used in various ASTM tests for density and specific gravity. These bring together for the first time the detailed requirements for the manufacture of such hydrometers which are now specified in a number of individual Society standards. The specifications cover plain hydrometers and thermo-hydrometers with the thermometer in the body or in the stem. Requirements are included for the API short and long form hydrometers. Included also are hydrometers for the specific gravity of light liquids and heavy liquids, and also for testing soil suspensions. The complete specifications will be submitted to letter ballot vote of the subcommittee.

Metalware Laboratory Apparatus:

The Subcommittee on Metalware Laboratory Apparatus has been especially active on improvements in the metalware apparatus now specified in Society standards. The Task Group on Laboratory Ovens has drafted a specification for the cell-type oven with controlled rates of ventilation. This oven is suitable for determining loss of weight or changes in properties of materials on heating at elevated temperatures. A proposed air cell bath, after review by the subcommittee, will be referred to the interested technical committees.

Another important development was the standardization of the thermometer ferrule so that it will be interchangeable with the Tag Closed Cup Tester and the Pensky-Martens Tester used in the flash point tests. Critical dimensions locate the opening of the thermometer collar for the cover of the tester and for the ferrule itself. This recommendation will be presented to Committee D-2 for inclusion in ASTM Methods D 56 and D 93.

A task group was appointed to review the apparatus for determining softening point by the shouldered ring. A new design of the trap used in the Standard Method of Test for Water (D 95) was approved for submission to Committee D-2 and any other committees interested. A progress report received from Committee E-3 on Chemical Analysis of Metals related to requirements for analytical balances, such subjects as sensitivity, performance characteristics, etc.

Action was taken to recommend to Committee D-2 that in its several distillation methods, the seamless brass tubing used in the apparatus should be specified as $\frac{5}{16}$ in. OD by 0.031 to 0.036 in. wall, rather than to specify No. 20 Stubbs gage.

An improved design of the penetration cone used in the Method of Test for Penetration of Lubricating Greases (D 217 – 48) was also approved for submission to Committee D-2.

Porous Filtering Bodies:

The Task Group on Porous Filtering Bodies is continuing its study of the operating characteristics and terminology of porous (fritted) filtering ware. The objective is the standardization of test procedures and particularly terminology so that the user may be aided better to select from the apparatus available the particular grade which will have maximum utility for each specific purpose.

Although specific emphasis is being placed upon filters for laboratory use, considerations are fundamental and the conclusions should be of general application to other designs of filtering media under study, such as fritted glass, ceramic, and metal.

The current project concerns two principal aspects of these filtering media: maximum pore size (retentiveness) and permeability (speed). It now appears that a standard method and terminology for pore size can be developed rather promptly. Considerations of permeability are somewhat more complex and may, therefore, require somewhat more exploration and time.

See page 25 if you are interested in a free trip to the 50th Anniversary Meeting.

Library Binding Institute

A note from the Library Binding Institute, 501 Fifth Ave., New York 17, an association of leading binderies throughout the country, states that on request they will furnish the names and addresses of binderies which they have certified in particular areas. They will also send instructions for preparing periodicals for Class A binding.

Binding is done in accordance with the American Library Association "Minimum Specifications for Class 'A' Library Binding," a standard of materials and construction needed for durability, flexibility, and service in a bound volume.

Certain library binderies which have proved themselves reliable, responsible, and able to do binding in accordance with these specifications have been granted certification by the Joint Committee of the American Library Association and the Library Binding Institute.

SAE-ASTM Technical Committee on Automotive Rubber Holds Fifty-eighth Meeting

THE 58th meeting of the Technical Committee on Automotive Rubber, which functions under the joint auspices of the ASTM and the Society of Automotive Engineers was held in Detroit on December 12, 1951. Preceding the meeting of the joint committee, meetings of the various sections and subgroups of the Technical Committee were held on December 10 and 11.

The joint committee took final action on a further revision of the Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (ASTM D 735; SAE R 10). An important addition to the revised specifications was a new table of physical requirements for synthetic rubber compounds designated as Type T, Class TA, temperature resistant. This new type covers the silicone compounds which are intended for service where a specific resistance to the effects of prolonged exposure to abnormal temperatures is required.

A new Tentative Recommended Practice for Classifying Elastomeric Compositions for Resilient Mountings has been approved by letter ballot of the committee and presented to the parent societies for publication. This recommended practice provides a means for classification of compositions based on the Yerzley's mechanical oscillograph for measuring mechanical properties in accordance with ASTM Method D 945. Requirements for the new polyacrylate rubbers are being considered for inclusion in these specifications.

Five new specifications for hydraulic hose have been approved by vote of the committee and submitted to the SAE for publication covering the following types of hose:

Single wire braid, rubber covered hydraulic hose,
Double wire braid, rubber covered hydraulic hose,
Single wire braid, cotton covered hydrauli chose,
Two braid fiber (nonmetallic), rubber covered hydraulic hose, and
Wire inserted, hydraulic suction hose.

The matter of test liquids or reference fuels used in immersion tests of rubber and rubber-like materials was the subject of considerable discussion. ASTM Method D 471 specifies two reference fuels: reference fuel No. 1 diisobutylene and reference fuel No. 2, a mixture of diisobutylene benzene, toluene, and xylene, both with inhibitor. In addition there are now three other reference fuels for immersion tests in military specifications. This has resulted in the need for laboratories maintaining supplies of five different fuels for these tests. A questionnaire has been circulated to members of the committee and also to the membership of Subcommittee XIX on Tests for Properties of Rubber and Rubber-like Materials in Liquids of ASTM Committee D-11 on Rubber and Rubber-like Materials. When results of this questionnaire are available it is planned to hold a joint meeting of all those interested, including representatives of Government, aeronautical, and other interested laboratories, so that full consideration can be given to this important matter.

New Specifications for Rubber Cups for Hydraulic Actuating Cylinders for Heavy-Duty Vehicles (SAE R-62) have been completed and the companion Specifications for Rubber Cups for Passenger Cars and Other Moderate-Duty Vehicles (SAE R-60) brought up to date. Both specifications cover performance tests for the cups under specified conditions but do not include requirements relating to chemical composition, tensile strength, etc. It was announced that the committee will undertake the preparation of specifications for brake boots for automotive vehicles.

The new Specifications for Nonmetallic Gasket Materials for General Automotive and Aeronautical Purposes (ASTM D 1170; SAE R-90) are now being published by the parent societies. The committee is conducting round-robin tests on impregnated paper gaskets of the glue-glycerin type and is also investigating the Mullen bursting strength test for gaskets.

The increasing use by automobile manufacturers of colored rubber mats and other rubber trimming for the interiors of passenger cars has made it necessary for the committee to consider techniques for color matching, to measure color changes during service, and also to tear and abrasion resistance of mats and similar interior rubber furnishings. In studying the color problem, the committee has given consideration to use of the Color Harmony Manual developed by the Container Corporation of America. This manual appears to be particularly well suited to the problems being encountered in the automotive rubber industry. The committee expressed considerable interest in a Symposium on Color Difference Specifications to be sponsored by ASTM Committee E-12 on Appearance, at its meeting to be held in Cleveland during ASTM Committee Week.

The Section on Static Exposure Testing reported plans for a comprehensive series of outdoor exposure tests on 8 rubber compounds at 17 locations. Mounted specimens of all 8 compounds are to be sent each month for 12 months to each of the exposure stations. Test exposures will be made for one calendar month at the end of which period the specimens will be returned to a central testing laboratory for rating and the obtaining of information on seasonal variations. The exposure test stations are distributed throughout the United States in Texas, California, Florida, Arizona, Illinois, Delaware, Michigan, New York, Ohio, Massachusetts, and Indiana.

The section on Low Temperature Properties of Elastomers submitted for vote a new tentative recommended practice for determining low-temperature properties of automotive rubber compounds, covering the following four types of tests: flexibility, compression, brittleness, and hardness.

ASEE Invites Contributions to Teaching Aids Catalog

A CATALOG of Teaching Aids which will contain reviews of means and devices suitable for use in the teaching of various engineering subjects is being prepared by the American Society for Engineering Education.

The purpose of the Catalog which in its first edition will be limited to the fields of civil, electrical, and mechanical engineering, mathematics, and engineering mechanics, is to help the engineering teacher choose those teaching aids which best meet his particular needs and provide him with the assurance that they have been passed upon by qualified individuals. It will endeavor to show industry what engineering educators want in this respect with the hope that industry will use the information as a basis for planning its own contributions.

The Catalog will include a brief description of each teaching aid and a review prepared by a committee of three educators in that field. Further information as to dimensions and physical characteristics of the device; where it may be obtained and whether there is any charge for its use, will also be included.

ASEE invites members of industry, professional societies, research organizations, and engineering colleges to send information on teaching devices to Carl W. Muhlenbruch, Chairman, ASEE Committee on Teaching Aids, Northwestern Technological Institute, Evanston, Ill., who will see that they reach the appropriate reviewing group.

Devices in the first edition will be limited to motion picture films, 2 by 2-in. or 3¼ by 4-in. slides, models, charts, and exhibits.

Society Purchases Ground for Expansion of Headquarters

To provide room for expansion of Society Headquarters, the Board of Directors has purchased for the Society a plot of vacant ground 80 by 129 ft immediately to the rear of the present headquarters across Quarry Street. The ground runs from Quarry Street south 129 ft to Cherry Street, an east-west thoroughfare, on which the frontage is 80 ft. The lot is twice the area of that upon which the headquarters building now stands; the cost was $29,000, about $2.75 a square foot.

When the headquarters building was acquired in 1945 it had been expected that the comfortable capacity of the building would be reached in about 1954, but the Staff has grown so rapidly in the past six years that we are approaching capacity sooner than expected. It had originally been planned, when more space was required, to extend the rear portion of the building to four stories; but this would have provided less than 1000 sq ft of office space, which at best would be nothing more than a stopgap. As it is, even that possibility of expansion is not permitted in the recently revised Philadelphia Building Code, which limits to three stories (as at present) any building of masonry and wood-joist construction. Hence the decision of the Board to acquire additional land, which we feel fortunate to to have obtained adjacent to our present location.

The Board of Directors will consider at its meeting on January 22 the steps that should now be taken to provide the required additional accommodations for Society offices, especially for all facilities devoted to sales, storage, and shipping of publications. We are finding, too, that space devoted to editorial and publishing activities is becoming unduly crowded for most efficient work. Such studies as the Board decides to make will necessarily involve some long-range planning, not only with respect to the future growth of the Society but also to plans for development of Philadelphia's Parkway that are being studied by municipal authorities.

Membership Growing—1951 Record Good

Although the number of new members received into the Society during the calendar year 1951 did not establish a record, it was the third highest in our history. The figure of 672 new companies, individuals, and institutions compares with 686 and 680, the high years of 1946 and 1947. However, in using these figures one should keep in mind two significant facts—the number of company and sustaining members included, and the percentage of losses during the year—because after all, it is the net gain which is one end objective. On both scores 1951 was really an outstanding year. Some 40 companies that previously had been affiliated with ASTM in a corporate capacity agreed to transfer their memberships to the sustaining class, taking advantage of the incentives offered sustaining members including extensive publication privileges, and at the same time, through the annual dues of $150 aiding in a substantial way to underwrite the Society's work, so significant to industry.

The aggregate losses from resignations, deaths, and other causes were considerably lower in 1951 than in any recent years. So, relating this fact to the excellent number of new members, the Society's membership has grown encouragingly during 1951.

The Membership Committee of the Board of Directors, which has membership growth under constant survey and endeavors throughout the year to interest companies and individuals in our work, is naturally pleased with this situation. The Directors serving on it, and in fact all officers of the Society, recognize the paramount importance in membership growth of the continued interest and activity of the current membership. It is in large measure their activity and support which insure a steadily growing Society.

Safety and Hazard Precautions in ASTM Standards

Many ASTM standards include precautionary notes or references to safety and hazard provisions. The question has been raised concerning the Society's responsibility in connection with such provisions. The advice of the Society's legal counsel is to the effect that there is no legal responsibility involved on the part of the Society—that such responsibility rests with the manufacturer or supplier of the materials involved, or the employer of the laboratory personnel making use of the materials described in the standards. The Society, however, would wish to encourage safety and to make such references as may be helpful.

The Board of Directors, at its meeting on September 18, established the following as the policy of the Society:

> Where there are personal hazards in methods of test, a warning should be given to this effect, pointing out briefly where, in the method, these hazards exist, and the protective or precautionary measures to be taken. It should be recommended that operators consult their supervisors or safety personnel for more detailed instructions.
>
> A statement should be included in the method that where more information is required, inquiry be directed to ASTM Headquarters.

The last recommendation is included having in mind that any inquiries received at Headquarters would be referred to the appropriate technical committees.

Sustaining Membership

As noted elsewhere in the Bulletin, the year 1951 proved an outstanding one in growth of the ASTM Sustaining Membership class. As this issue goes to press the total number of sustaining members is recorded as 252, the four most recently authorizing such transfer being:

- Northern States Power Co., J. J. Brennan, Manager, Supplies and Testing
- Radio-Television Manufacturers Assn., Virgil M. Graham, Associate Director, RTMA Engineering Dept.
- Rome Cable Corp., R. A. Schatzel, Vice-President and Director of Engineering
- Henry Vogt Machine Co., Archibald Hurtgen, Chief Metallurgist

The following listing gives a picture of the diverse industries represented in this sustaining membership group.

Automotive, Aircraft	7
Bituminous, Tar, Chemicals, Wood, etc.	7
Cement, Lime, Gypsum, Ceramic	17
Chemical Manufacturing, Plastics, Adhesives, Paints, Soaps, Naval Stores, etc.	30
Communications, Gas, Power and Light, etc.	19
Electrical Manufacturing, Electrical Insulating, Cable, etc.	9
Engineering Services	4
Ferro-Alloys, etc.	3
Instruments, Scientific Apparatus, and Testing Equipment	10
Iron and Steel Production	23
Iron and Steel Products (as distinct from steel manufacturers—forgings, strip, castings, piping, pressure vessels, carbuilding, wire, etc.)	30
Machinery, Miscellaneous Manufacturers, Glass, Business Machines, etc.	19
Marketing, Mail Order, etc.	2
Non-Ferrous Metals and Alloys	23
Petroleum Products	23
Railroads and Railroad Equipment	9
Rubber and Rubber-like Materials	6
Textiles	11

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Samuel E. Q. Ashley, Head, Chemical Section, Transformer and Allied Products Div. Laboratory, General Electric Co., Pittsfield, Mass., has been elected Secretary of Analytical Section, International Union of Pure and Applied Chemistry.

George Beiser, Office of Technical Services, U. S. Department of Commerce, Washington, D. C., was one of several technical experts honored recently by the Department of the Army for valuable contributions to the nation while serving overseas with the Technical Intelligence Industrial Committee, Joint Chiefs of Staff, during World War II. Mr. Beiser investigated the development of plastics in Germany for possible future use in military aircraft.

W. E. Bradley, formerly Assistant to Vice-President, Union Oil Co. of California, Wilmington, is now Manager of Research.

Jose Baraquiel Calva, Chemical Engineer, and President and Technical Director, J. B. Calva & Co., Minneapolis, Minn., opened the annual series of lectures sponsored by the University of Puebla, Mexico, in December, in a talk entitled "Industrial Generation and Utilization of Nuclear Energy." Dr. Calva, formerly a member of the faculty of chemistry at the National University of Mexico, became a permanent resident of the United States in 1929. He is presently Chairman of the Twin Cities Section of the American Institute of Chemical Engineers.

Byron F. Campbell has been appointed Executive Engineer for Harry Ferguson, Inc., Detroit, Mich. Associated with Ferguson for the past six years, Mr. Campbell until recently was Chief of Laboratories.

Bernard C. Case, formerly Field Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J., has been appointed Manager of Electrochemical Development for his company.

Walker L. Cisler, until recently Executive Vice-President, The Detroit Edison Co., Detroit, Mich., has been named President and General Manager of the company.

Nelson E. Cook, General Superintendent of Galvanizing Operations, Wheeling Steel Corp., Wheeling, W. Va., was recently presented with the Annual Award of the Galvanizers' Committee of the American Zinc Institute, in recognition of his "distinguished service in the field of galvanizing."

Farrington Daniels, Professor of Chemistry at the University of Wisconsin, has been chosen President-Elect of the American Chemical Society for 1952. Dr. Daniels, who has held many ACS offices, administrative as well as editorial, is the author of a number of textbooks on physical chemistry, his field of research being chemical kinetics.

Arno C. Fieldner, Chief Fuels Technologist, U. S. Bureau of Mines, Washington, D. C., and internationally known inventor and developer of many techniques of testing and analyzing coal, coke and gas, was presented with an honor award by the Washington Society of Engineers in November. In recognition of outstanding professional achievement, this award has been in existence for many years but has been presented only four times previously. Dr. Fieldner, who has been with the Bureau of Mines for more than 40 years, is the author of more than 400 monographs, bulletins, articles, and technical publications on fuel testing and research. Affiliated with ASTM since 1914, Dr. Fieldner is a Past-President and Honorary Member of the Society.

M. R. Gallo, formerly with Clark Bros. Co., Inc., Olean, N. Y., is now representing the Buflovak Equipment Division of Blaw-Knox Co., Buffalo, N. Y.

Samuel H. Graf, Director, Engineering Experiment Station, Oregon State College, Corvallis, was re-elected a regional vice-president of The American Society of Mechanical Engineers at its annual meeting in November.

William A. Gruse, Administrative Fellow, Petroleum Refining Fellowship, Mellon Institute, received the 1951 Award of the Pittsburgh Section of the American Chemical Society, presentation being made at a dinner at the University Club in Pittsburgh in December. The award has been made annually since 1933 for "outstanding service to chemistry."

Max Hansen, Assistant Chairman of the Metals Research Dept., Armour Research Foundation of Illinois Institute of Technology, Chicago, has been promoted to Chairman of the Department. He succeeds **Carl Swartz,** who has been named Metallurgical Consultant.

Henry G. Hoskins, formerly Chief Metallurgist, Aluminum Co. of South Africa, Pty., Ltd., Pietermaritz, Natal, South Africa, is now associated with the Australian Aluminum Co., Pty., Ltd., Wahroonga, New South Wales, as Remelt Supervisor.

John R. Jackson, Mechanical Engineer, Association of American Railroads, Chicago, Ill., has retired after more than 40 years in railroad service. A long-time member of ASTM, Mr. Jackson has been very active through the years on several ASTM technical groups, including Committees D-2 on Petroleum Products and Lubricants, D-5 on Coal and Coke, and D-11 on Rubber and Rubber-Like Materials.

Bayard S. Johnson, of Franklin Research Co., Philadelphia, Pa., was elected to serve a three-year term as a member of the board of governors of the Chemical Specialties Manufacturers Assn.

The many friends in ASTM of **Jonathan Jones,** Chief Engineer, Fabricated Div., Bethlehem Steel Co., Inc., Bethlehem, Pa., are congratulating him on the honorary membership accorded him by the American Society of Civil Engineers. A leader in the structural field for many years, formerly with McClintic-Marshall and later with Bethlehem, Mr. Jones has made many contributions. In ASTM his major field of interest has been in connection with specifications for structural steel, and no small measure of the standing of these widely used ASTM standards is traceable to his constructive interest down through the years. He is the Vice-Chairman of Subcommittee II on Structural Steel for Bridges, Buildings and Rolling Stock of Committee A-1 on Steel.

Carl M. Loeb, Jr., Vice-President, Climax Molybdenum Co., New York City, has become a member of the Board of Sponsors of the American Baseball Academy, New York, a new organization formed to combat juvenile delinquency in metropolitan areas.

Charles W. MacGregor, Professor of Applied Mechanics and Head of the Materials Div., Massachusetts Institute of Technology, has been named Vice-President of the University of Pennsylvania, in charge of engineering and scientific studies, the position being a new one established by the university's board of trustees. He will begin his new duties in February. A member of ASTM for many years, Dr. MacGregor was awarded the Charles B. Dudley Medal by the Society in 1941.

Louis McDonald, formerly Head, High Explosives Section, U. S. Naval Ordnance Test Station, Inyokern, Calif., is now Technical Director, Kelite Products, Inc., Los Angeles, Calif.

Clinton K. Mitchell, for many years Director of Laboratories, W. B. Coleman & Co., Philadelphia, Pa., has accepted a position as Director of Research with the Lehigh Chemical Products Co., Chestertown, Md. This company, which specializes in synthetic lubricants for aircraft, for use at extreme temperatures, recently has started operation of a new plant, and is generally expanding its production.

L. B. Parsons has been appointed Director of Research and Development for Lever Brothers Co., Cambridge, Mass. Mr. Parsons joined Lever Brothers as a research supervisor in 1939, and served successively as chief chemist, manager of basic research laboratories, and assistant director of research and development.

Phillips Petroleum Co., Bartlesville, Okla., received the 1951 *Chemical Engi-*

neering Achievement Award, formal presentation being made by *Chemical Engineering*, at a dinner at the Waldorf-Astoria Hotel in New York in late November. This high honor came to Phillips for its two concurrent commercial developments in synthetic rubber technology: high abrasion carbon black and cold rubber. Another ASTM member, **Alfred H. White,** Professor Emeritus of Chemical Engineering at the University of Michigan, was Chairman of the Award Committee. K. S. Adams, Chairman of Phillips Co. Board, accepted the Award for his organization.

F. Warren Porter, formerly Paint Chemist, Maryland State Use Industries, House of Correction, Jessups, Md., is now associated with the Rheem Manufacturing Co., Sparrows Point, Md., as Paint Finishes Technologist.

E. O. Rhodes, Manager of Development, Tar Products Div., Koppers Co., Inc., recently became Chairman of the Pittsburgh Section of the American Chemical Society.

Edgar A. Rodruan is now Chief Metallurgist for Donegal Mfg. Corp., Marietta, Pa.

H. F. Schiefer, Physicist (Textiles), National Bureau of Standards, Washington, D. C., has been on leave of absence for work at the North Carolina State College Textile School covering research on the effect of construction factors on the resistance to abrasion, especially in relation to the many new types of floor covering appearing on the market. In cooperation with ASTM Committee D-13 on Textile Materials, it has been agreed that an experimental study be undertaken to show performance in use, and to ascertain the extent to which laboratory tests can be relied upon to evaluate wear resistance.

Alexander Smith, Inc., Yonkers, N. Y., has announced the appointment of **Leo W. Rainard** as Director of Research. Mr. Rainard was formerly Assistant Director of Research under **A. Griffin Ashcroft** before the latter's election last year as Vice-President in Charge of Research and Development. Mr. Rainard's appointment is part of a general realignment of Alexander Smith's research and development activities to keep pace with the increasing diversity of the company's operations. Previously associated with Atlantic Research Associates, General Latex and Chemical Co., and the Institute of Textile Technology, he has a varied background of experience in research and development of fibers and fabrics.

Foster D. Snell, President, Foster D. Snell, Inc., New York City, has been elected President of the International Fat and Oil Commission of the Union of Pure and Applied Chemistry.

Ernest L. Spencer, formerly Assistant Professor of Civil Engineering at Northeastern University, Boston, Mass., has been appointed Associate Professor. Professor Spencer is in direct charge of the Concrete Laboratory which is used for instructional and research purposes at the University. The laboratory is under the general supervision of Professor **Emil A. Gramstorff.**

L. K. Stringham, until recently Director of Welding Development, has been appointed Chief Engineer for Lincoln Electric Co., Cleveland, Ohio.

Paul D. Strubhar, formerly Chief Metallurgist, Remington Rand, Inc., Norwalk, Conn., is now associated with the Radio Corporation of America, Lancaster, Pa., as Senior Metallurgist.

Willis F. Thompson, Chief Mechanical Engineer, Westcott & Mapes, Inc., New Haven, Conn., was elected a regional vice-president of The American Society of Mechanical Engineers at its annual meeting in November.

E. W. Upham, Chief Metallurgist, Chrysler Corp., Detroit, Mich., retired in December, after upwards of 35 years of service with his company and its predecessor organizations. When he went to work with the Maxwell Motor Co. in the early 1900's he was the sole metallurgist in the organization. A member of the ASTM Board of Directors 1941–1943 during the period when the Society geared its activities to contribute in many important ways to the war effort, Mr. Upham really gave freely of his time and widespread knowledge in planning and carrying out important phases of the work. One of his very constructive efforts involved the hardenability test for steel where as chairman of a special committee in A-1 on Steel he directed the development of the widely used ASTM hardenability test standard (A 255). He also assisted in the work of the ASTM Detroit District, and served on other ASTM committees including the Administrative Committee on Simulated Service Testing. His many friends and associates in the Society, and in fact in the numerous other groups to which he contributed, will extend to him and Mrs. Upham best wishes in his retirement. He is maintaining his residence at 38082 Weston, Birmingham, Mich.

Don S. Urquhart has been named Product Engineer for the Wel-Met Co., Kent, Ohio. He was formerly associated with the U. S. Graphite Co., Saginaw, Mich.

F. J. Walsh, until recently Laboratory Supervisor, Canadian General Electric, Ltd., Toronto, is now Canadian Sales Representative for the American Chemical Paint Co. of Ambler, Pa. He may be addressed at St. George, Ont., Canada.

We note an honor accorded one individual who, though not a member of ASTM, certainly understands and helps to promote the use of our books. Dr. Evan Jay Crane, editor of *Chemical Abstracts*, received the Priestley Medal, top ACS award, at the Diamond Jubilee meeting of the American Chemical Society. His supervision of *Chemical Abstracts* has brought renown to the Society and to his editorial associates and himself. Though we in ASTM try religiously to keep him supplied promptly with every one of our new publications, down through the years we have had friendly gentle reminders on occasion that such and such a book "has not been received—would we please check up?"

Dr. Crane was in France recently as the U. S. delegate to the Committee on Chemical Abstracting called by UNESCO. He also spoke last month before a joint meeting of the ACS and the Society of Chemical Industry in London.

NECROLOGY . . .

The death of the following members has been reported

WILLIAM FORREST ANGUS, President of Dominion Bridge Co., Ltd., and of Dominion Engineering Works, Ltd., Montreal, Canada (October 14, 1951). Member since 1904. A graduate of McGill in 1896, Mr. Angus' entire business career was principally associated with the steel industry. He had been with the Dominion Bridge Co. for many years, becoming Vice-President in 1917, and President in 1936. In the latter year he also became President of the Associate Company, Dominion Engineering Works, Ltd. In addition to these main business interests, Mr. Angus also was identified with the following companies as a director: The Royal Bank of Canada, The Montreal Trust Co., The Bell Telephone Co., Northern Electric Co., Foundation Co., Canadian Locomotive Co., Eastern Canada Steel Co., and Dominion Hoist & Shovel Co. The son of R. B. Angus, one of the great figures in the industrial and financial development of Canada, and an original promotor of the Canadian Pacific Ry., Mr. W. F. Angus ably carried on the tradition of the family name, not only in the business world but as a philanthropist and counselor, being universally known and respected for his lifelong application to business, his skill in the handling of industrial problems, and his sympathetic interest in many charitable activities.

C. E. FULTON, Chief Ceramic Engineer, Pittsburgh Plate Glass Co., Glass Div., Research Lab., Creighton, Pa. (November 20, 1951). Affiliated with the Society as a personal member since 1945, Mr. Fulton had represented his company since 1930 on Committee C-8 on Refractories and several of its subgroups.

J. F. GARNEAU, Mica Fabricators Assn., New York City (October 16, 1951). Represented the Association in the Society and on Committee D-9 on Electrical Insulating Materials.

FREDERICK J. GRIFFITHS, executive and consultant in the steel industry, Massillon, Ohio (November 23, 1951). Member since 1915. Mr. Griffiths founded Central Steel Co. in 1913, later becoming its president, and on the merging of the company with United Alloy in 1926 became chairman of the board of the new company, Central Alloy Steel Co. The latter firm eventually became a part of Republic Steel Corp., and Mr. Griffiths then served as Chief of Republic's research division. He subsequently became president of Timken Steel & Tube Co., and from 1939 to 1941 was executive vice-president of Copperweld Steel Co.

ALBERT LONDON, Physicist, National Bureau of Standards, Washington, D. C. (November 18, 1951). Representative of the Bureau on Committee C-20 on Acoustical Materials, in which he had taken an active part, especially as Chairman of the Subcommittee on Maintenance, also as a member of the Executive Committee of C-20, and the subgroup concerned with Sound Absorption. He had served since 1948 as a consulting member of Committee E-6 on Methods of Testing Building Constructions and its Subcommittee on Sound Transmission.

WILLIAM B. ROSS, Director of Research, Pure Oil Co., Chicago, Ill. (November 19, 1951). Representative of his company since 1937 on Committee D-2 on Petroleum Products and Lubricants, and numerous of its sections and subgroups. A graduate of Wooster College and Massachusetts Institute of Technology, Mr. Ross served in the United States Army Chemical Warfare Service, was later in research work at MIT, and was then for many years in charge of chemical engineering at the Research and Development Laboratories, Socony-Vacuum Oil Co. before going to Pure Oil Co. in 1935. He had written many technical papers and was active in several societies.

WILLIAM L. SULLIVAN, Chemical Engineer, Westinghouse Electric Corp., Lamp Div., Bloomfield, N. J. (April 23, 1951). Member since 1948.

LEWIS G. WILSON, retired President, Precision Thermometer and Instrument Co., Philadelphia, Pa. (November 12, 1951). An active member of ASTM for many years, Mr. Wilson in his younge years was on the technical staff of the James W. Queen Co., one of the early and largest laboratory supply houses in the country. He left this company in 1910 to found the Precision Thermometer Co. Throughout his entire career he was associated with many of the current leading executives in the apparatus field, and was instrumental in the development of many mercurial precision instruments, ultrasensitive thermostats and high-temperature glass thermometers. He was very active in the Scientific Apparatus Makers Association, the Engineers Club of Philadelphia, and in ASTM was concerned particularly with the work of Committee E-1 on Methods of Testing. He served also on other technical groups and was a member of the Philadelphia District Council.

NEW MEMBERS...

The following 7 members were elected from November 15, to December 21, 1951, making the total membership 7096 ... Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals.

Chicago District

BREITFUSS, THOMAS KIELY, Assistant to the Managing Director, American Concrete Pipe Assn., 228 N. La Salle St., Chicago 1, Ill.

MACHATTIE, IAN, Ekco Products Co., 1949 N. Cicero Ave., Chicago 39, Ill.

New England District

CARHART, FRANK M., Partner, Jackson & Moreland, 600 Park Square Bldg., Boston 16, Mass.

New York District

AIR REDUCTION CO., J. K. Hamilton, Manager, Development Div., Research and Engineering Dept., Murray Hill, N. J.

U. S. and Possessions

HUGHES GUN CO., H. C. Dill, Chief Metallurgist, Box 2545, Houston, Tex.

Other than U. S. Possessions

ERBEN, ADOLF SCHMIDS, INC., Hermann P. W. Wanner, Managing Director, Postfach Transit, Berne, Switzerland.

MOLINDER, GORAN, Chief Metallurgist, Uddeholms Aktiebolag, Munkfors, Sweden.

Calendar of Other Society Events

"Long" and "Short" calendars will appear in alternate BULLETINS. *The "Short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.*

INTER-SOCIETY COLOR COUNCIL—February 7–9, Annual Meeting, Statler Hotel, New York, N. Y.

NATIONAL SAND & GRAVEL ASSOCIATION and NATIONAL READY MIXED CONCRETE ASSOCIATION—Week of February 11, Joint Exposition and Convention, The Stevens, Chicago, Ill.

AMERICAN INSTITUTE OF MINING and METALLURGICAL ENGINEERS—February 18–21, Annual Meeting, Hotel Statler, New York, N. Y.

SOCIETY OF THE PLASTICS INDUSTRY (CANADA) LTD.—February 21–22, 10th Annual Conference, Royal York Hotel, Toronto, Canada.

American Society for Testing Materials—March 3–7, Spring Committee Week, Hotel Statler, Cleveland, Ohio.

AMERICAN SOCIETY OF CIVIL ENGINEERS—March 5–7, Spring Convention, New Orleans, La.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—March 10–14, Annual Conference and Exhibition, Buccaneer and Galvez Hotels, Galveston, Texas.

AMERICAN RAILWAY ENGINEERING ASSOCIATION—March 11–13, Annual Meeting, Palmer House, Chicago, Ill.

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.—March 11–14, Fifth National Plastics Exposition, Convention Hall, Philadelphia, Pa.

W. J. Grede, ASTM Member, Elected President, National Association of Manufacturers

THE election of an ASTM member as President of the National Association of Manufacturers, calls for more than a brief notation, particularly if that member has been active in ASTM committee work. Early in December papers throughout the country announced that William J. Grede, President, Grede Foundries, Inc., Milwaukee, Wis., was the new NAM President. He has represented his ASTM company membership for a number of years, and not so long ago was chairman of a subcommittee in Committee A-3 on Cast Iron which developed important specifications covering lightweight and thin-section castings (A 190). One news account pointed out that Mr. Grede is particularly proud of his employer-employee relations, and many constructive projects in this field have been instituted in his company.

ASTM has among its members many presidents, executive vice-presidents, and others in managerial and executive capacities. We are pleased to have Mr. Grede head of such an influential group as NAM, and extend him best wishes for a very constructive regime.

The Society Appoints...

Announcement is made of the following appointments of Society representatives

D. K. SPRING, Henry Disston & Sons, Inc., for one year, and G. O. HIERS, National Lead Co., for two years, on the Administrative Committee on District Activities.

E. F. SEAMAN, Bureau of Ships, U. S. Department of the Navy, on the Administrative Committee on Simulated Service Testing for a term of one year.

E. R. STIVERS, Package Research Laboratory; H. A. BERGSTROM, Continental Can Co.; A. V. GRUNDY, Subsistence Research and Development Laboratory; and T. A. CARLSON, U. S. Forest Products Laboratory, as ASTM representatives on the Joint ASTM-TAPPI Committee on Shipping Containers.

FRED BURGGRAF, National Research Council as ASTM representative on the American Documentation Institute.

W. S. HOUSEL, University of Michigan and Michigan State Highway Department, as alternate on the Highway Research Board of the National Research Council, succeeding F. E. RICHART, deceased.

N. T. F. STADTFELD, Board of Water Supply, New York City, as an additional ASTM representative on ASA Committee A-21 on Cast Iron Pipe.

E. V. BENNETT, Bethlehem Steel Co., as ASTM representative on ASA Sectional Committee B-17 on Standardization of Shafting and Stock Keys.

W. J. KIERNAN, Bell Telephone Laboratories, Inc., as ASTM representative on ASA Sectional Committee Z-58 on Optics, succeeding M. REA PAUL.

On nomination by the Chairman of the Washington (D. C.) District Council, E. W. BAUMAN, Managing Director, National Slag Assn., will represent the ASTM Washington Council on the Board of Standards and Appeals of The Maryland National Capital Park and Planning Commission.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

Universal Testing Machine—The new Baldwin Sonntag Model 12-H Universal Testing Machine of 12,000 lb capacity is presented in Bulletin 336 with four illustrated pages covering design features, operation, and specifications.

Baldwin-Lima-Hamilton Corp., Testing Equipment Dept., Philadelphia 42, Pa.

Indicator Solutions and Reagents for pH Control and Water Analyses—A new attractive catalog of indicator solutions and reagents for pH measurements, water and chemical analyses with Hellige Colorimetric Comparators employing Non-Fading Glass Color Standards is available. It is stated in the catalog that to insure accurate results and minimize expenses, the components of less stable reagents are furnished separately so that they can easily be mixed as needed. Catalog items are listed under three headings: Indicator Solutions Required for Pocket and Standard Comparators; Reagents Required for Pocket and Standard Comparators; and Reagents and Indicator Solutions Required for Hellige Aqua Tester.

Hellige, Inc., 3718 Northern Blvd., Long Island City, N. Y.

Pressure Reaction Apparatus—A pressure reaction apparatus with motor-driven stirrer for hydrogenation, alkylation, hydrolysis, polymerization, and numerous other chemical pressure reactions on a laboratory scale is described in a new six-page bulletin. This apparatus is available in either 1000- or 2000-ml sizes for work at pressures and temperatures from atmospheric to 1000 psig at 350 C. The apparatus consists of a stainless steel bomb, electric heater with variable voltage controller and stirrer drive motor, all assembled on a steel base. The Series 4500 apparatus features a convenient closure design which permits opening and closing the bomb without disturbing the head fittings.

Parr Instrument Co., 211 Fifty-third St., Moline, Ill.

Radioactivity Measurements—A 12-page illustrated price list on instruments and accessories for radioactivity measurements is available free from Radiation Counter Laboratories, Inc. This price list shows scalers, nucleometers, rate meters, scintillation counters, scintillation crystals, water monitors, health protection instruments, Geiger-Mueller and proportional counters, flowing gas counters, shields, absorbers, holders, warning placards, micropipets, and special gases.

Radiation Counter Laboratories, Inc., 1844 W. 21st., Chicago 8, Ill.

Oscillographs—A new bulletin describing direct recording oscillographs and associated amplifiers is available from Rahm Instruments Inc. The Rahm RO Direct Recorder and OB Amplifiers are newly engineered instruments designed to provide the optimum in linearity and frequency response characteristics while maintaining versatility of application and structural ruggedness. The RO Recorders and OB Amplifiers are said to offer a heretofore unobtainable choice of dc and ac-dc recording-amplifying systems making possible a selection of low or high gain units for a wide range of input levels.

Rahm Instruments, Inc., 12 W. Broadway, New York 7, N. Y.

Analytical Filter Papers—A new catalog of analytical filter papers also contains reference information on chemical analyses and biological procedures. In addition to detailed descriptions of a complete line of filter papers and accessories, the catalog includes a 12-page reference table for filtrations in methods of inorganic analysis. It also contains such information as literature references of Government publications dealing with analytical filtering, methods for testing filter papers, etc.

Schleicher & Schuell Co., Keene, N. H.

Laboratory Glassware—Scientific Glass Apparatus Co., Inc., has just announced the issuance of the 14th edition of their publication entitled "What's New for the Laboratory." Among the many new items illustrated and described is a self-pumping still, an electric pipet washer and dryer, automatic pipet and vial filling machine, angle head centrifuge, improved 5-gallon can spigot, flexible manometer, precision balance, and teflon-coated ground glass joints.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Instrument Notes

Cantilever Beam Load Cell—A new instrument for changing a mechanical force into a proportionate electrical signal that is transmitted to an indicator or recorder for evaluation has been developed by Automatic Temperature Control Co. The load cell operates on the simple cantilever beam principle, having one end of the beam fixed and applying force to be measured to the free end of lever. The motion of the beam moves the armature in the linear transducer and an electrical signal is generated. Successfully applied to testing machine applications, the beams have a maximum stress of less than 30,000 psi. Up to four cells may be connected mechanically to a single platform, for scale applications, and the cells electrically connected together in series so that the forces are added electrically. Available in standard ranges from 5 lb to 500 lb. Equipped with zero adjustment.

Automatic Temperature Control Co., Inc., 5200 Pulaski Ave., Philadelphia 44, Pa.

Bolt Extensometer—A new type bolt extensometer designed for accurate tensional tests of bolts without the influence of shifting of grips or seating of the specimen, is announced by Baldwin-Lima-Hamilton Corp. Since the method of attaching extensometer arms to standard cylindrical specimens cannot be applied to threaded bolts, attachment has sometimes been made on the grips. Any shifting of the grips and seating of the specimen, therefore, distorts extensometer measurements. To avoid the possibility of such errors the new extensometer has been designed to contact the center of the ends of the bolt, thus it is said making direct and exact measurements of elongation. If the extensometer is left in position until actual fracture of the bolt, a complete load-elongation curve can be obtained, showing ultimate strength and over-all elongation.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Creep Recorders—Two new recorders for Baldwin lever-type creep machines and 4000-lb creep-relaxation testing machine are announced by Baldwin-Lima-Hamilton Corp. Creep specimen deformation of 0.020 in. produces full-scale pen carriage movement of 10 in. across a strip chart. The chart is driven at ¼ in. per hr by a synchronous motor. A 150-ft chart roll gives a 7200-hr record (300 days). For creep-relaxation records a conventional variable miniature transformer type strip chart recorder has been developed. The lowering of stress in a specimen, maintained at constant tensional strain at any temperature up to 1800 F, is recorded by a conventional Microformer type servo system operated as an extensometer on a spring block loading device through which constant strain is maintained.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Manometer Accessory—A new product, called the Mercureceiver, is designed to trap mercury blown from manometers and achieve equilibrium readings in ten seconds or less. This new laboratory aid also dampens surges and pulsations, filters actuating media, and prevents loss of mercury at normal operating pressures, it is stated. The unit is a moly or stainless steel container with threaded end fittings and porous stainless steel membranes. The Mercureceiver is equipped with a porosity HX membrane capable of preventing passage of mercury from the manometer at pressures under 17 psi. Finer porosities are available on request for prevention of loss at high pressures.

Chemiquip Co., 6 E. 97th St., New York 29, N. Y.

Mass Spectrometer—A new model has been added to the line of mass spectrometers manufactured by Consolidated Engineering Co. This new instrument, the Model 21-401, is a dual-purpose mass spec-

trometer designed for the analysis of mixtures of gases and light liquids, as well as for determination of ratios of stable isotopes. It is expected to fill a particular need in laboratories having moderate analytical loads of a routine nature and be valuable in research and exploratory applications involving both mixture analysis and stable isotope tracer techniques. The new mass spectrometer is quite compact and has many design features. The complete elimination of refrigerants, such as liquid nitrogen, is expected to result in a reduction of operating costs to the user. Numerous automatic devices are said to minimize operator errors and effect a saving in the time required for analysis. For mixture analysis, the 21-401 mass spectrometer has a mass range of 2 to 100, with automatic scanning and recording of spectra from mass 12 to 100. It is claimed that about 15 or more complete runs can be made in an eight-hour shift. The spectra are recorded on a strip-chart recorder, and automatic attenuation of peak magnitudes provides a dynamic recording range of 300,000 to 1. For isotope-ratio work, such as the determination of the ratio of N^{15} to N^{14} in a sample of nitrogen, performance of the instrument is unusual in that the ratio is not only obtained directly, by an automatic null balancing method, but is also recorded. Within sensitivity limitations, any ratio from 0 to 1.0 can be measured. The first three decimal places are obtained from decade dials; the last three from pen-and-ink record. The conversion from mixture analysis to isotope-ratio measurements can be accomplished in a matter of minutes.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

X-Ray Diffraction Spectrometer—An improved "Norelco" Geiger-counter recording X-ray spectrometer with wide-range goniometer of unusual design is available from the Research & Control Instruments Div., North American Philips Co., Inc. The complete assembly consists of three components: (1) basic X-ray diffraction unit, (2) wide-range Geiger-counter goniometer, (3) electronic circuit panel with strip chart recorder. The new instrument is used for X-ray powder diffraction work and fluorescence analysis and incorporates a novel X-ray optical arrangement which gives extremely high resolution. Basic X-ray diffraction unit is designed to operate on 200–240 v ac, 50 or 60 cycles, with full-wave rectification and facilities for visual indication of tube functioning. X-ray tube current is provided with stepless controls to give up to 60 kvp and 50 ma, indicated on precision meters. The wide-range Geiger-counter goniometer is designed to scan and analyze X-ray diffraction spectra of specimen materials by divergent-convergent beam-focusing geometry. It is built for high precision and provides for accurate measurement of angles from −38 to +180 deg, with a useful X-ray diffraction range from 38 to 165 deg. The goniometer scanning has a horizontal axis, and is synchronous motor driven in either direction at five different speeds. Stop limits and operational controls allow single-scan or oscillatory scanning in any part of the range. Specimen shaft rotates in a precise 1:2 angular rate relationship with the concentric goniometer shaft. Angle of inclination of specimen face to the horizontal can be varied begween 0 deg to an upper limit of 80 deg.

North American Philips Co., Inc., Res. & Contrcl Insts. Div., 750 S. Fulton Ave., Mt. Vernon, N. Y.

Tin Plate Thickness Gage—An improved tin plate thickness gage which provides a nondestructive method for checking use of this metal, is currently in production at the Research and Control Instruments Div., North American Philips Co. The design utilizes an X-ray beam which is directed upon the surface of the sheet under test. Through proper kilovoltage control of the beam, the tin plating is penetrated, the beam striking the underlying steel. Rays emitted by the iron are measured by means of Geiger counters and the intensity can be expressed as a logarithmic function of tin plate thickness. In practice this is reduced to a reading on a printing register.

North American Philips Co., Inc., Research & Control Instruments Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

Horizontal Iron Shield—A newly designed mount and shield for side window glass Geiger tubes, designed to eliminate unsatisfactory features of previously available models, is announced by Nuclear Instrument & Chemical Corp. This new Model 3030A shield is arranged for mounting of a glass Geiger tube horizontally and placement of a sample close to this tube surrounded by 2½ in. of iron for background shielding purposes.

Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago, Ill.

Line-Operated pH Indicator and Vacuum Tube Voltmeter—A new line-operated pH indicator and vacuum tube voltmeter developed by Leeds & Northrup is said to be unaffected by normal fluctuations in line voltage or by zero drift of the amplifier. A converter-type instrument, its circuit employs dc to ac conversion, ac amplification, and conversion back to dc for voltage feedback. Conversion stabilizes zero; feedback stabilizes gain.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Laboratory Furniture—Stainless steel tops for laboratory furniture are now offered by Fisher Scientific Co. The tops are manufactured in Fisher shops to fit basic models of Fisher Unitized Laboratory Furniture. Each top, supported by thick plywood sections, is made in one piece with an integral splashback and reagent shelf. Stainless steel used in the new tops contains over 30 per cent non-ferrous alloying materials, making it highly resistant to the action of common laboratory reagents. All edges of the tops are a continuation of the upper surface and adjacent edges are clearly welded. The front edge is not sharp-angled but rolled for the protection of the laboratory worker.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

NEWS OF COMMERCIAL TESTING AND RESEARCH LABORATORIES

EDITOR'S NOTE.—We should like to make a place in the BULLETIN news columns for important events, unique research projects, unusual projects completed, and other items of interest with respect to commercial testing and research. The items below are an attempt in this direction. Obviously, the BULLETIN cannot hope to cover completely the commercial testing field, but it will from time to time, attempt to note important items relating to these organizations. The information will be based on literature and statements from the various firms concerned.

Electrical Testing Laboratories, Inc., N. Y.—The October, 1951, issue of *ETL Notes* contains under the heading "Independent Audits" a description of the value to a business organization of employing a commercial laboratory to run an independent study of inspection and testing operations in much the same way that an independent audit is often made of accounting practices. The article states: "Just as the certified public accountant verifies the financial records by checking bills, vouchers, entries in the books of account, and the like, so an independent inspection and testing 'auditor' would verify compliance of inspection and test records with the applicable specifications or instructions. He would also determine adequacy of the inspection and test records with the applicable specifications or instructions. He would also determine adequacy of the inspection and testing procedures and their compliance with generally recognized good practice." The benefits to manufacturer and customer alike of such an

---

To the ASTM Committee on Membership

1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on membership in ASTM and include a membership application blank.

Signed _____

Address _____

Date _____

audit are listed in detail. Other items in the publication discussed fluorescence in compass liquids, engineered plant design, testing of freezers for frozen foods, acceleration tests of aviation devices, and simulated weather testing.

Sam Tour & Co., Inc., N. Y.—A recent news release discussed the problem of nondestructive determination of thickness of ship hulls and bulkheads. Traditionally, such thickness determinations had been made by drilling up to 500 holes in a vessel when its age indicated that a thorough examination was due. Since the advent of the ultrasonic audigage, findings on several recent projects were satisfactory to the extent that the official marine surveyors did not even require check holes.

Foster D. Snell, Inc., N. Y.—Recently announced is a new artificially soiled cotton fabric that is designed for general use in the laboratory. The fabric is so soiled that it resembles natural grease, grime, and dirt and is designed so that it can give results by being washed once. The new soiled cloth will be supplied as FDS Soiled Cotton. The soil consists of a mixture of carbon, saturated fatty acids, saturated oils, and mineral oil. Saturated oils are used to minimize tendency for the soil-removal characteristics to change with age. It is said that over a long period of time—at least several months—detergency readings obtained with this cloth do not change. Detergency reading is defined as brightness regain during detergent wash minus brightness regain during a control wash with plain water. Tests indicate that this fabric gives good correspondence of results to full-scale washings of naturally soiled fabrics in machines. Soil removal value has been set at an intermediate range, large enough to permit measurement of brightness gain during a single laboratory wash, but small enough to permit use in multiwash tests.

INSTRUMENT COMPANY NEWS . . . .

Announcements, changes in personnel, new plants and locations, and other notes of interest

Southern Scientific Co., Inc., one of the five divisions of Will Corporation, distributors of laboratory apparatus and supplies, has moved into its newly built warehouse and offices at 890 New Chattahoochee Ave., N. W., Atlanta, Ga. This new plant has three times the floor space of the previous Atlanta location.

Taylor Instrument Cos., Rochester, N.Y. Raymond E. Olson, newly elected president of the Taylor Instrument Cos., has announced several major changes in the supervision of the sales department. Olson was formerly vice-president and general sales manager. Appointed to replace him as general sales manager is Frank S. Ward (Scottsville, N. Y.), who since 1945 has been industrial sales manager. Ward's place as industrial sales manager is being taken by Albert J. Fleig, who since 1945 has been divisional sales manager in charge of sales to the chemical, petroleum, and canning industries.

Central Scientific Co. For the academic year 1952–1953 Central Scientific Co. will offer two scholarships for graduate study at advanced degree levels. One is for $1000 for a Master's degree and the other $1500 is for the Doctor's degree. They are limited to the physical sciences and engineering and to citizens of the United States. Any student interested in these scholarships may apply in writing, giving data including personal record and description of his research problem. Direct letters of recommendation from former teachers and friends are requested. Write, Scholarship Committee, Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill., before April 15, 1952.

Consolidated Engineering Corp., Pasadena, Calif. The appointment of Joseph H. Lancor, Jr., as Director of the Transducer Div. of Consolidated Engineering Corp. has been announced by Philip S. Fogg, president of the company. In his new position, Mr. Lancor will supervise and direct the design and development of transducers of various types including vibration pickup, accelerometers, and pressure pickup.

Weston Electrical Instrument Corp., Newark, N. J. The appointment of Anthony H. Lamb as vice-president in charge of manufacturing is announced by Earl R. Mellen, president of Weston Electrical Instrument Corp. Mr. Lamb, who started with the Weston Co. in 1924 as an instrument assembler, became a vice-president in 1950 in charge of the company's Tagliabue Instruments Div. He holds a Personal Achievement Award from the United States Navy for developing special instruments for the Armed Forces. Mr. Lamb succeeds Reginald R. Lambe who has retired after 35 years of service.

Notes on Annual Meeting of National Lubricating Grease Institute

MANY ASTM members and technical men active in ASTM Committee D-2 on Petroleum Products and Lubricants participated in the 19th Annual Meeting of the National Lubricating Grease Institute, held in late 1951 in Chicago. Retiring President **Howard Cooper,** Chief Lubrication Engineer, Sinclair Refining Co., New York City, delivered an inspiring opening address characterized by a brief outline of growth and achievements. The organization in 1933 included 22 company members, and the attendance at the first meeting (in that year) totaled 46. At the 1951 meeting the registration was 446, and the organization had grown to include 120 company members. According to the December, 1951, issue of *The Institute Spokesman*, the general consensus following the recent meeting was that it was by far the largest in NLGI history and certainly the most enthusiastic. In addition to the ASTM Petroleum Committee, NLGI has established cooperative relationships with the Lubrication Committee of the American Petroleum Institute, Society of Automotive Engineers, and the American Standards Association.

George E. Merkle, Vice-President, Fiske Brothers Refining Co., Newark, N.J., is the 1952 President of the Institute. **Charles B. Karns,** Manager, Esso Standard Oil Co. of Pennsylvania, Pittsburgh, was re-elected Treasurer. Other ASTM'ers taking part in the meeting included: **M. R. Bower,** Standard Oil Co. (Ohio), **Arthur J. Daniel,** Battenfeld Grease and Oil Corp., **H. P. Hobart,** Gulf Oil Corp., **L. W. McLennan,** Union Oil Co. of California, **William H. Oldacre,** D. A. Stuart Co., **T. G. Roehner,** Socony-Vacuum Oil Co., Inc., and **F. E. Rosenstiehl,** of The Texas Co.

The longest distance traveler was **Hermann P. W. Wanner,** Managing Director of Adolf Schmids Erben, Inc., who came from Berne, Switzerland. His company is an active member of NLGI, joining during the past year. This company also subscribed to ASTM affiliation in 1951.

To the ASTM Committee on Membership, 1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below:

_____

_____

This company (or individual) is interested in the following subjects: (indicate field of activity, that is, petroleum steels, non-ferrous, etc.,)

_____

Signed _____

Date_____ Address_____

BOOK REVIEWS...

Physics of Lubrication

THIS publication contains the papers presented at a symposium held jointly by the British Rheologists' Club and the Manchester and District Branch of The Institute of Physics from June 29 to July 1, 1950. Of the 18 papers given, 4 deal with hydrodynamic lubrication and 14 with boundary layer and extreme-pressure lubrication.

The papers are in general of a high order of excellence, including many recent data along many lines of investigation. Under hydrodynamic lubrication appear the radial spreading of pools of liquids, a study of lubricating oils at high rates of shear, and the lubrication of textile fibers. A partial list of the subjects touched upon in the boundary layer and extreme pressure section includes radioactive tracer studies of adsorption and surface damage, scuffing temperatures and surface changes in scuffing, spreading and lubricating properties of mixed liquids, lubrication by solids, metallic soaps, and long-chain organic compounds, and the electrostatic component of the force of friction. Discussions of the papers have been included.

In addition to the papers describing original research, summaries of the fields of hydrodynamic and boundary lubrication are provided by two recognized authorities, Prof. D. G. Cristopherson and Dr. D. Clayton. Many other well-known scientists have contributed papers and criticisms. The book is a handy collection of articles that might otherwise have appeared in a dozen different journals.

The collection is published as a 1951 Supplement No. 1 to the *British Journal of Applied Physics* by The Institute of Physics, 47 Belgrave Square, London, S.W.I. The price is 15/.

J. C. GENIESSE

Report of the Correlating Committee on Cathodic Protection

AUTHENTIC recommendations for correlating cathodic protection systems on underground metallic structures are given in the 33-page "Report of the Correlating Committee on Cathodic Protection," which has been published by the National Association of Corrosion Engineers. The report consolidates and revises the four bulletins prepared by the committee to aid in solving the problems created when adjacent underground metallic cables, pipe lines, and rail track are protected from corrosion by applied cathodic currents.

The committee is composed of representatives of eleven trade and professional organizations and large commercial institutions operating the principal underground metal plants in the United States. Sponsor organizations are American Gas Assn., American Petroleum Inst., American Public Works Assn., American Water Works Assn., Association of American Railroads, Bell System, Edison Electric Inst., International Municipal Signal Assn., Inc., National Association of Corrosion Engineers, United States Independent Telephone Assn., and Western Union Telegraph Co.

The report consists of a foreword and the four bulletins as follows:

Bulletin I—Management Information on Cathodic Protection of Buried Metallic Structures Against Corrosion,
Bulletin II—Cathodic Protection Notification Procedures,
Bulletin III—Cathodic Protection Technical Practices, and
Bulletin IV—Joint Cathodic Protection Systems.

The procedures included in the report have been endorsed as good practice by all concerned. In consideration of the billion-dollar annual loss to American industry from underground corrosion, every operator of underground metallic plant should read the report.

Copies of the book may be obtained from the National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2, Texas, at 50 cents a copy.

Revised Edition of "The Making, Shaping, and Treating of Steel"

THE sixth, and certainly a most significant edition, of the book "The Making, Shaping and Treating of Steel" has recently appeared. Extensively revised and brought up to date, this is one of the most valuable references and texts those concerned with the metallurgy of steel can have.

Since the first edition of this book, which was prepared by Messrs. J. M. Camp and C. B. Francis (the latter very active in ASTM), each succeeding edition has been recognized as an authoritative treatise on the technical aspects of producing and evaluating steels and their products. The current edition has been, in considerable part, rewritten as a cooperative effort of the top technical personnel of the U. S. Steel Corp. subsidiaries. Messrs. Bain, Grossmann, Austin, and other authorities in the corporation cooperated in this edition. Two significant improvements involve the 713 illustrations, most of them new, and the detailed subject index expanded to 150 pages. The latter makes it much easier than with former editions to refer to specific topics in the 1600-page book.

The 38 extensive chapters, beginning with fundamental principles, refractories, fuels, etc., carry through completely to cover this wide field, with closing chapters covering stainless steels, steels for elevated temperature service, mechanical testing, and gage numbers. Several chapters have been almost completely rewritten.

Published on a nonprofit basis, the sixth edition of "The Making, Shaping, and Treating of Steel" can be procured from the Treasurer, United States Steel Co., 525 William Penn Place, Pittsburgh 30, Pa. It is priced at $7.50, but for use in schools and colleges, a special price of $5 per copy applies. With its great amount of authoritative data on steel, this book is a real buy.

Chemical and Physical Determinations for Porcelain Enamel Plants

THE data contained in this 8½ by 11-in. booklet published by the Ferro Corp. of Cleveland was compiled by Michael Bozsin, an analytical chemist who has directly supervised most of the development and testing of the techniques described in this publication.

The object of this compilation as stated in the preface is to "describe, in detail, quantitative analytical procedures for the determination of all deleterious gases (halides, sulfur compounds, moisture, carbon monoxide, and oxygen), pyrometric and draft measurements and their significance for the production of quality porcelain enameling and lowered rejects, with consequent savings in operating costs."

The six chapters cover Chemical Procedure, Sources and Effect of Sulfur Trioxide on Porcelain Enamel, The Effect of Fluorine and Chlorine on Enamel Plant Operation, Determination of Combustion Efficiency, Draft Determination and Pyrometric Practice, and Determination of Fire-box Temperatures.

A bibliography is included in this 76-page booklet and an extensive appendix of charts and tables covering, among other things, relative humidity, vapor pressure, and temperature conversion.

Methods of Operations Research

FOR all those who must provide their executive departments with a quantitative basis for decisions regarding the operations under their control, this new book, "Methods of Operations Research," will be of much interest, even though most of the examples covered relate to work by the authors, Messrs. Philip M. Morse and George E. Kimball, in the U. S. Navy.

The book is an attempt to demonstrate how this science, which is defined as a scientific method of providing the data noted in the first sentence, can be applied to various fields. The authors note that the final aim of operations research, which differs from ordinary statistical analysis, is to predict future operations and to understand them in order to modify them to produce better results. Various scientific techniques are used.

This publication, jointly issued by The Technology Press, MIT, and John

Wiley & Sons, 440 Fourth Ave., New York 16, N. Y., defines the science, gives an idea of the boundaries of its usefulness, explains the tools to be used, presents keenly interesting applications to military problems—for example, antisubmarine flying in the Bay of Biscay, damage by suicide planes—and finally a discussion of organizing an operations research group.

There is a detailed subject index, a bibliography, and some mathematical tables. Printed very clearly, with good size type, page size 8 by 10½ in., this 160-page publication lists at $4.

Hydrogen Embrittlement of Steel

A REVIEW of the literature on this subject by R. W. Buzzard and H. E. Cleaves of the National Bureau of Standards has been issued as Circular 511. Listing 1191 papers this 32-page document should be invaluable as a reference on hydrogen embrittlement. Conclusions reached on the review are that steel absorbs hydrogen on exposure to the gas at an elevated temperature or in the environment of a chemical reaction. Initial concern of hydrogen so absorbed centered in the tendency to cause porosity and blowholes in the cast metal. Subsequently the list of defects attributed to hydrogen was greatly enlarged to include flaking, pickling embrittlement, shatter cracks, hairline cracks, weldment failures, and numerous other service failures. The data presented in the literature fail to establish quantitative proof that hydrogen is the sole cause of these defects, but it is well established that when procedures for maintaining the hydrogen content at a minimum are utilized, certain defects generally ascribed to hydrogen can be eliminated.

This 32-page document can be obtained for 20 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Paint and Varnish Production Manual

A DIRECT outgrowth of activities sponsored by the Federation of Paint and Varnish Production Clubs, the recently issued Paint and Varnish Production Manual meets a need, long recognized, for assembling in one volume the basic knowledge of production facilities and methods employed by the paint industry. Edited by Verne C. Bidlack, President, Pennsylvania Color and Chemical Co. (and former Secretary of the Federation), and Edgar W. Fasig, General Superintendent, The Lowe Brothers Co. (the latter a Past-Director of ASTM), the book contains helpful information on all phases of the protective coatings industry—new equipment, new handling techniques, inventory control, production scheduling, better filling, packing, and labeling methods, and factory cost accounting. It further offers excellent suggestions for laboratory procedure, and gives important rules for fire prevention, safety, and health. Quoting from the preface, it "has been designed for the education of production personnel in the manufacture of surface coatings and for those interested in the problems of management."

After a brief introduction, the book begins with a detailed discussion of plant facilities, presenting information on such vital factors as location, plant design, equipment, materials handling, heat, light, and power. The individual requirements for paint and varnish plants are considered separately. Engineering factors covered include general procedure, production planning and control, maintenance, and obsolescence. The book gives an over-all picture of the industry—from initial planning to the final shipping of the product.

All who are responsible for transforming company policies into tangible results in the paint and similar industries should obtain many valuable suggestions from this 288-page Manual published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., and selling for $6.50.

Dollar Savings Through Standards

THIS timely report issued by the American Standards Association presents a summarization of data obtained in a recent survey to ascertain the economic savings derived from the use of standards by American industry. Quoting from the foreword, " 'Dollar Savings Through Standards' is an attempt to compile a body of measurable proof in terms of dollars or percentages of net savings and specific economic benefits attributable to standardization. The first survey of its kind, it represents 140 documented case studies, covering 81 industries and industrial products. Most of this information was supplied (for distribution abroad) to the Economic Cooperation Administration through the American Standards Association, which got it in a special survey of its 110 trade association and technical society members, and 2000-odd company members. . . . ASA undertook the inquiry as a service to American industry, as well as a powerful means of bringing about the adoption of efficient practices in other countries on whose production the United States must rely in no small degree to conserve our own productive capacity. As a member of the 31-nation International Organization for Standardization (ISO), ASA has a further interest in presenting the points of view of American industry to industrialists of other countries. It was felt that this report would make an important contribution to the literature in the field of international standardization."

Quoting further from the foreword, "the most obvious generalization that can be drawn from the results of the survey is that standardization is truly an essential element of the American industrial system. Another important observation is that standardization programs in all degrees of development are currently to be found. The cases show various stages, ranging from elaborate and well-established procedures to initial or tentative efforts. The larger the industrial establishment the more important it is that the fullest possible use be made of standards at every stage of the productive process."

The investigation disclosed that in many instances records of specific savings were not kept although decisions were reached at an early date that standards were essential. On the other hand, some manufacturers maintain accurate records showing the extent of application of standards and the annual savings attributable to their use. While the most substantial contributions to the survey, and those from the largest establishments, came from correspondents who did not return a check list accompanying ASA's request for information, nevertheless the following analysis of such check lists returned from 61 companies (representing broad industrial coverage) and marked to show the fields of standardization in which savings had been achieved, is interesting and significant:

1. The greatest number (over 75 per cent) derived savings from reduced inventories of materials, parts, and end products. Nearly the same number (72 per cent) listed purchasing "larger quantities of fewer items" and the use, in engineering, of "accepted standard specifications *versus* special specifications" as sources of savings.
2. The next greatest number (67 per cent) gave "buying most economical quantities," "use of industry, national, or other standard specifications," and "variety reduction and interchangeability" as sources from which they had derived savings.
3. With the exception of economies derived from modular coordination the remaining items of the check list were marked by from 26 per cent to 54 per cent of those returning the list. Of these items, "fewer materials and smaller varieties of parts" and "minimum storage and warehousing costs" stood highest; "economies of special-purpose machines" was lowest.
4. Ten per cent indicated that they had derived savings from "modular coordination."
5. Forty per cent of the lists returned gave credit to standardization for "improved inter-departmental coordination."

The "cases" presented are roughly

divided under generalized headings, and there are two full alphabetical indexes, the first listing the reporting industries, and the second indicating the various subjects of standardization discussed. ASTM members may well be gratified to note a number of references to the use of ASTM standards by companies reporting, also to participation of company technical men in the activities of the Societies.

Individual copies of the report, issued in the form of an attractive 32-page, 8¼ by 11¼-in. brochure, are obtainable at $1 each from the American Standards Assn., Inc., 70 E. 45th St., New York 17, N. Y. (ECA is distributing the document abroad; in this country, copies can be obtained only through ASA.)

Effect of Temperature Papers at ASME Meeting

SEVERAL interesting technical papers featured sessions of the Annual ASME Meeting, November 25–30. These were given in sessions sponsored by the Joint Committee on Effect of Temperature on the Properties of Metals, and included the following:

- A Time-Temperature Relationship for Rupture and Creep Stresses—Frank R. Larson, Watertown Arsenal, and James Miller, General Electric Co.
- Effect of Temperature Variation on the Long Time Rupture Strength of Steels—Ernest L. Robinson, General Electric Co.
- High-Temperature Stress-Rupture Testing of Tubular Specimens—Lambert F. Kooistra, Robert U. Blaser, and James T. Tucker, Jr., The Babcock & Wilcox Co.
- Rupture and Creep Characteristics of Titanium-Stabilized Stainless Steel at 1100 to 1300 F—James W. Freeman, University of Michigan, George F. Comstock, National Lead Co., and A. E. White, University of Michigan.
- Behavior of Superheater Tubing Materials in Contact with Combustion Atmospheres at 1350 F—Howard A. Blank, A. M. Hall, and J. Harry Jackson, Battelle Memorial Institute.
- Fabrication of High Temperature Test Racks—Bela Ronay, U. S. Naval Engineering Experiment Station.
- Experimental Superheater for Steam at 2000 psi and 1200 F—Progress Report of Field Operation—Frederic G. Ely, Consultant, and Fritz Eberle, The Babcock & Wilcox Co.

There was considerable interest in the paper by Messrs. Larson and Miller which describes methods by which short-time tests can be used to determine long-time properties. If this system is practical and feasible, it would cut down a great deal the amount of time necessary to determine the long-time properties of metals.

Bureau of Standards Notes

WILLIAM BLUM, Assistant Chief of the Chemistry Division and Chief of the Electrodeposition Section, retired December 31, after more than 42 years on the Bureau Staff. A member of ASTM since 1929, Dr. Blum last year was presented by the Society with an Award of Merit, in recognition of pioneering research leading to development of a widely used group of specifications for electrodeposited coatings which in large measure have been responsible for improved quality of plated materials. Other recognitions accorded Dr. Blum were the presidency of the Electrochemical Society (1926) and its top award, the Acheson Medal (1944), the medal of The American Institute of Chemists (1926), honorary membership in the American Electroplaters' Society and its special award (1928).

GORDON M. KLINE, formerly Chief of Organic Plastics Section, is now Chief, Division of Organic and Fibrous Materials. Dr. Kline is Chairman of ASTM Committee D-20 on Plastics, and also serves on other technical groups of the Society. A photograph of Dr. Kline, together with his interesting article, "Preservation of the Declaration of Independence and the Constitution of the United States," appeared in the December ASTM BULLETIN, page 32.

ARCHIBALD T. MCPHERSON has been appointed Associate Director of the Bureau. As Associate Director he will be responsible for the coordination and direction of the Bureau's work in calibration, testing, and specifications. Dr. McPherson, who has been on the NBS Staff since 1918, became Chief of the Rubber Section in 1930, and Chief of the Organic and Fibrous Materials Division in 1943, continuing in the latter position until his recent appointment. The major part of his scientific work has been concerned with rubber research, including investigations of the electrical, optical, and thermodynamic properties of rubber and research in rubber technology. During the World War II rubber shortage he served as a technical adviser on the Rubber Survey Committee. He has published many research papers on such subjects as the change in volume of rubber during stretching, methods for the purification and characteristics of purified rubber, and the dielectric properties of rubber, as well as articles in other fields of organic chemistry.

A. T. McPherson

Durability of Nylon

RECENT investigations of the mechanism of the deterioration of Nylon have been carried out by the National Bureau of Standards and are reported in the Bureau's Technical Report 1591.

Thin films of plastics were exposed to heat, ultraviolet light, various ambient atmospheres in specially designed apparatus, and accelerated weathering and outdoor exposure tests. Among the techniques employed to determine changes were infrared and ultraviolet absorption, measurement of viscosities, dielectric constant and dissipation factor, X-ray and electron microscopy.

Three types of changes were found to occur: (1) breakdown of the polymer molecules at the C—N bond of the peptide group; (2) changes in molecular orientation and crystallinity as a result of hydrogen bridging, hydrocarbon packing, dipole arrangement etc.; (3) the amount of organic liquids sometimes changed.

Results indicate that service life of Nylon can be extended by protecting against ultraviolet radiation. Water content should be maintained at a relatively high value and loss of organic liquid prevented. Detrimental effects of changes in crystallinity and orientation can be partially avoided by changing the chemical composition of the polymer although knowledge of the effects of interaction of other groups, if substituted, is limited.

Research on Electrodeposition at the National Bureau of Standards

DR. William Blum, who retired on December 31 after more than 42 years on the staff of the National Bureau of Standards, summarized the research work of the Bureau in the field of electrodeposition in the December *NBS Technical News Bulletin*. He pointed out that in these studies the Bureau cooperated actively with other Government agencies, the International Association of Electrotypers and Stereotypers, American Electroplaters' Society, and the ASTM. Numerous Federal and ASTM specifications are based in part on the results of Bureau research. The Bureau's research in the field of electrodeposition covers chromium plating, nickel deposition, electrodeposition from nonaqueous solutions, and principles of electrodeposition.

Dr. Blum has been an active member of the ASTM for more than 20 years and was one of the 1951 recipients of the ASTM Award of Merit.

Ignition of Fibrous Materials by Self-Heating

RECENT investigations by the fire protection laboratory of the National Bureau of Standards have proved conclusively that closely packed fibrous materials can ignite by self-heating. The tests showed that the extent of the temperature rise depends upon the material,

its density and packing, the ambient temperature, and the length of time this state is maintained.

The initial tests made on wood fiberboard specimens 0.01 to 12 in. in diameter indicated that the larger the volume of the specimen the greater is the self-heating temperature rise within the specimen for a given ambient temperature and the lower is the external temperature required to initiate combustion. Data were also obtained on cane fiberboards, felted cotton linters, Douglas fir, crushed coal, and alfalfa hay.

It appears probable that extremely large volumes of fibrous materials will ignite at relatively low ambient temperatures and that a potential fire hazard exists in the transportation and storage of these materials, especially after hot processing and drying.

Glass Paper Developed at NBS

THE National Bureau of Standards in cooperation with the Naval Research Laboratory has developed paper composed entirely of glass fibers with no additive.

This new paper, until now considered an impossibility, has several important applications. NBS tests show it to be especially effective as an air filter. Tests also indicate that the paper has high resistance to effects of heat, moisture, chemicals, and microorganisms and should be valuable as an electrical insulator and dielectric. It can be used to make oil-impregnated paper capacitors capable of operation at temperatures above 200 C.

Commercially available fine glass fibers of finest diameter—0.75 μ or less—mixed with water, made papers with the best strength and filtering characteristics. The glass fiber and water stock was flowed onto a 29-in. Fourdrinier machine with a 70-mesh wire 33 ft in length. From the endless-belt wire screen, the wet paper passes between special rollers, through a series of driers, and onto a reel. It was found that wet paper could not be passed through metal rollers without weakening and pinholing. With a cushioning jacket on the first press roll, however, the wet paper was satisfactorily pressed against the felt surface under the paper with minimum injury to the fibers.

Experiments revealed that strength of the paper depends upon the presence of fibers of assorted lengths, but that very short fibers weaken the paper if present in substantial quantities. When paper was made of a mixture of fibers run through classifier screens of 65, 100, 150, and 200 mesh, its tensile strength was ten times greater than that of the original paper. This significant increase apparently resulted from the removal of fines or fillers that passed the 200-mesh screen.

Standard Design Practices

RECOMMENDED to conserve scarce materials and thus allow for more construction in 1952, the Defense Production Administration has adopted a program devised by its Conservation Coordinating Committee which embodies a set of standard design practices recommended by the Facilities and Construction Bureau of the National Production Authority. The program is backed by the 17 Government agencies connected with the mobilization program as represented on the Conservation Coordinating Committee.

Among the recommendations included in the memorandum are the following:

1. Structural and reinforcing steel may be conserved by using wall-bearing masonry construction in lieu of structural steel or reinforced concrete frames.

2. Savings of approximately 50 per cent in steel may be made by use of reinforced concrete and even greater savings are possible when timber is used instead of structural steel.

3. Many steel conservation measures are available in reinforced concrete construction including flat slab construction instead of beam and girder; also the use of square or rectangular columns with ties instead of smaller columns with spirals.

4. In many instances fireproofing of adequate resistance may be obtained by use of noncritical materials. By using lightweight concrete and plaster aggregates, lower quantities of structural or reinforcing steel are needed for load-carrying members and foundations.

6. Enameled, plated, and stainless clad carbon steels are often suitable substitutes for the stainless steels which are generally in extremely short supply.

The seven design standards identified as "good practice, considered acceptable to most engineers, architects, building officials and municipalities," and recommended for use in conserving scarce materials are:

Structural Steel.—"Specification for the Design Fabrication and Erection of Structural Steel for Buildings," Am. Inst. of Steel Construction June, 1949.

Reinforced Concrete.—(ACI 318-51) "Building Code Requirements for Reinforced Concrete," Am. Concrete Inst.

Lumber.—"National Design Specifications for Stress-Grade Lumber and Its Fastenings," Natl. Lumber Mfrs. Assn., 1950.

Plumbing.—"National Plumbing Code" issued jointly by the NPA and the Housing and Home Finance Agency. June, 1951.

Electrical Work.—"National Electrical Code of the National Board of Fire Underwriters." 1947.

Light Gage Steel Made of Cold-Formed Sheet or Strip Less Than $\frac{3}{16}$ in. Thick.—"Light Gage Steel Design Manual," Am. Iron and Steel Inst. January, 1949.

Open Web Steel Joists.—"Standard Specifications for Open Web Steel Joist Construction," Steel Joist Inst. October, 1949.

Electrical Measuring Devices

THE second edition of the book "Mechanical Measurements by Electrical Methods" is available from the Instruments Publishing Co., Inc., 921 Ridge Ave., Pittsburgh, Pa. The work, originally published serially in *Instruments* magazine, is offered in a second edition without extensive revision. Separate chapters are included dealing with gaging methods based on variations of capacitance, inductance, and resistance. Photoelectric, piezoelectric, thermoelectric, acoustic, and other gaging methods are also described.

The book is fully illustrated with graphs, drawings, and photographs. Contents of the book are indexed alphabetically. An index of references cited is included. A supplementary bibliography of some 120 references refers to additional articles published since the book was written. The price is $4 per copy postpaid.

Building for the Future

THE chemical industry's obligation to translate the findings of science into the greatest good for the most people in the shortest time involves:

1. The greatest possible encouragement to discovery, commensurate with our resources and consistent with the aim of avoiding waste or priceless talents in unproductive pursuits.

2. A reduction of the time lag which, in the past, has run into decades and even generations—the lag between formulation of an important principle and application of that principle on a broad scale to human betterment.

3. Achievement of the maximum efficiency in quantity production, so that the benefits of discovery may be spread in volume at minimum cost.

—From a paper, "Building for the Future in Chemistry," by John E. McKeen, President, Chas. Pfizer & Co., Inc.

Will a Secretary Go to Heaven?

If a secretary writes a letter, it's too long.
If he sends a postal it's too short.
If he doesn't send a notice, he's lazy.
If he attends a committee meeting, he's butting in.
If he stays away, he's a shirker.
If he duns a member for dues, he's insulting.
If he fails to collect dues, he's slipping.
If he asks for advice, he's incompetent.
If he does not, he's bullheaded.
If he writes reports complete, they're too long.
If he condenses them, they're incomplete.
If he talks on a subject, he's trying to run things.
If he remains quiet, he's lost interest in the meetings.

Ashes to ashes,
Dust to Dust.
If others won't do it,
The Secretary must.

—Highway Builder

Standard Autoclave Test for Glazed Whiteware Products*

By John H. Koenig[1]

THE RESISTANCE of a glazed surface to crazing in the autoclave under steam pressure serves as a means of estimating the resistance of the ware to crazing in service when the body expands by the action of moisture, the glaze remaining practically unaltered.

Delayed crazing was believed by Schurecht (1)[2] to be due to the expansion of the body on chemical combination with absorbed water, while the glaze remains constant. This was substantiated by the fact that an increase in humidity accelerated crazing. Schurecht, using an autoclave, subjected test specimens to 150 to 175 psi steam pressure for 1 hr. This, he determined, had an effect comparable to the amount of crazing which would occur in more than one year of storage. The more matured the body, the less the moisture absorption and consequently the less crazing. Schurecht and Pole (2) discovered that bodies with low absorption composed of pure clay and feldspar developed practically no moisture expansion while those composed of clay, feldspar, and more than 20 per cent silica developed considerable moisture expansion (due to increased refractoriness and absorption of body).

Two different autoclave treatments were used by Wright (3); 3 hr at 100 psi and 2 hr at 150 psi steam pressure. Earthenware bodies were fired randomly to different maturity and consequently presented varied moisture absorption. From these test specimens the values of critical absorption for the two autoclave treatments were determined. It was found that the maximum per cent absorption that withstood crazing for an ivory body was 7 to 8 per cent when subjected to 100 psi. In the 150 psi steam test the critical absorption was lowered to 6 per cent.

Callcott (4) showed that crazing may be due to glaze application on too porous a body, or to incorrect firing. An excess of Na_2O in the glaze, of china clay in the body, or of related constituents may also result in crazing. Vitreous bodies deficient in flint are especially likely to craze. With composition unchanged, a longer firing or higher temperature would overcome crazing.

Geller and Creamer (5) demonstrated that fused feldspar is the most susceptible to moisture expansion of whitewares constituents. In general the relative amount of feldspar is the dominant factor for bodies having absorptions greater than about 10 per cent, and the absorption is the dominant factor for bodies having absorptions less than 10 per cent.

Mills (6) evidenced that the effect of duration of the steam test varied inversely as the pressure that was used. For pressures of less than 100 psi, a 2-hr test was advisable; at over 100 psi a 1-hr test was sufficient. Mills' apparatus utilized direct heat, and the pressure could not be increased as rapidly as with steam from an outside source. He, therefore, experienced no appreciable difference between the effects of slow and rapid rates of steam application. Pressure release was varied from a 2-hr natural cooling to an immediate release with no evident differentiation in the effects produced. Mills found the autoclave test to be cumulative in its effects, making it possible to compare ware which has withstood the original test to ware subjected to repetitions of the test. The effect of four separate tests at constant pressure and temperature for 1 hr was much greater than that produced by a test for 4 hr at that temperature and pressure. Crazing was attributed in part to a mechanical action of the steam pressure in addition to the permanent expansion of the body caused by the combination with water.

Holscher (7) concluded from his observations that, since bodies composed of feldspar, clay and flint had a higher volume increase than bodies having only clay constituents, the volume increase was not due to the rehydration of the clay molecules within the body. The entire gain in weight and length could not be accounted for by drying at 110 C. Holscher found that the composition of the body was a more important factor, in its reaction under autoclave treatment, than its absorption value. A constant steam pressure of 150 psi was maintained as other factors were varied.

Volume increases in porous ceramic bodies were concurrent with increases in weight, the two being almost proportional. The rates of both weight and volume increase were rapid at first, falling off with time. The rate-time curve was approximately parabolic. The indications were that expansion under autoclave treatment was not due to temperature or pressure but rather to water vapor or steam.

Treischel (8) found, as did Mills, that the cumulative test was much more severe than the continuous test. Treischel based his observations on glazed tile and described a simple apparatus for measuring their moisture expansion. Hagar (9) also described a procedure for the same measurement.

Schurecht and Pole (10) showed that the moisture expansion of certain glazes was similar to that of the body to which they were applied. This is an important aspect in that it is possible to fit a glaze and body so that the rate of expansion due to moisture absorption is the same for both. This lessens the susceptibility of the glaze to tensile stresses. An autoclave treatment of 150 psi steam pressure for 1 hr was used on test samples. This treatment produced an expansion of 0.004 per cent in lustrous glazes, 0.011 per cent in mat glazes, 0.005 per cent in vitreous glazes, and 0.033 per cent in porous slip finishes.

Some work was done by Burch (11) on the moisture expansion of glass. Filtration of saturated steam with partial removal of entrained water decreased the rate of decomposition of the glass in contact with the steam, but dry steam had no apparent effect on glass. For his test runs Burch used steam pressures of 35 psi for 5 hr.

Until recently, not much attention was paid to the rate of steam application in autoclave schedules. Most investigators used the classic 150 psi of steam for 1 hr with no allowance for rates of steam pressure application or release. As previously mentioned, Mills and Treischel both discovered that cumulative tests were more severe than the continuous type. Therefore, there must be some relation between rate of steam application and the severity of the autoclave test. As a result, recent investigators have used definite rates of steam application and release in their schedules.

Typical of this was the work done by Koenig (12). He used three autoclave schedules, designated as A, B, and C, in testing semivitreous china and hotel china. Schedule A was 1 hr at 150 psi pressure, B was 1 hr at 100 psi pressure, and C was 3 hr at 150 psi pressure. In each case the pressure was increased uniformly (close control was needed in building up, holding, and releasing the pressure) to reach 150 psi in 1 hr and was released at the same rate. (Schedule B, of course, took only 40 min to build up to 100 psi; the same length of

---

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at a meeting of ASTM Committee C-21 on Ceramic Whitewares at Bedford Springs, Pa., September 21, 1950.

[1] School of Ceramics, Rutgers University, New Brunswick, N. J.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

time was used to release the pressure. The rate was the same.)

Marquis (13) in working with cone 01 glazes for low-temperature vitreous bodies used a schedule which seems to have become quite conventional. Pressure was built up in 25-lb increments to 150 psi steam pressure in 1 hr. This pressure was maintained for 1 hr and then released in 25-lb increments over a 1 hr period.

Cook and Brunner (14) used a similar schedule in their work on whitewares. They used three autoclave schedules with maximum pressures of 50, 100, and 300-psi steam pressure. The rate of application and release of steam pressure for all was the same.

The correlation between steam duration and steam pressure advanced by Mills aided scheduling considerably. This work was supplemented by Mattyasovszky and Zsolnay (15) who showed that the autoclave test is proportional at every pressure to the results of boiling in water. One hour of autoclaving at 150-psi vapor pressure was equivalent to 3 hr at 100 psi, 1 hr at 100 psi was equivalent to 4 hr at 50 psi, and 1 hr at 50 psi was equivalent to 15 hr boiling in water.

For testing some materials, the autoclave treatment must be modified. Typical of this was the work done on hot-water tank enamels by Moore and Harrison (16). Various temperatures up to 482 F (562 psi steam pressure) and periods of treatment up to 5½ hr were used. Results differed greatly and could not be reproduced. Some enamels which were not considered suitable for hot-water tanks on the basis of experience, showed excellent resistance, and in some cases better resistance than nominally good tank enamels. As a result of all this, it was concluded that the autoclave would have to be modified in order to be of service in testing hot-water tank enamels.

The modified autoclave that Moore and Harrison used was essentially a pressure chamber through which water could be circulated at a controlled temperature and air pressure. It differed from the conventional autoclave in that (*a*) the temperature was lower, (*b*) the pressure was obtained from air, not steam, and (*c*) provisions were made for water circulation. This type unit had been previously used by Spencer-Strong of Pemco Corp.

Recommendations

The schedule of increasing the steam pressure, holding at the maximum for the prescribed period, and reducing the pressure must be rigidly controlled. This can be more readily achieved with an autoclave apparatus, where the steam is supplied from an outside source.

Various schedules have been used. The following schedule is recommended: Increase the steam pressure uniformly to 150 psi in 1 hr, hold at a pressure of 150 psi for 1 hr, and then decrease uniformly over 1 hr. The first signs of crazing constitute failure. The specimens, on removal from the autoclave, should be covered with a dye solution, then rinsed, and inspected for crazes.

COMPARISON OF AUTOCLAVE SCHEDULES FOUND IN REFERENCES.

Reference Number	Steam Pressure, psi	Time, hr
1	150	1
2	150	1
3 a	100	3
b	150	2
6	150	1
7	150	Varying
8	Built up to 150	½–¾
	Held	1
	Released quickly	..
9	150	1
10	150	1
11	35	5
12 a	150	1
b	100	1
c	150	3
13	Built up to 150 in 25-lb increments	1
	Held	1
	Released in 25-lb increments	1
14	15–100–300	1
	Held	1
	Cooled	1
15	150	2
16	80 (air pressure), temp. 140–300 F, 2 gal per min (continuous process)	0–2000
17	Built up to 150 in 25-lb increments	1
	Held	1
	Released in 25-lb increments	1
18	180	1
19	Built up to 15	30 min
	Maintained at this pressure and 121 C	1
	Released	30 min
20	150	3
21	Built up to 20–50	30 min
	60–100	1
	150	80–120 min
	Held 150	1
	Released	10–30 min
22 a	150	3
b	100	½, 1, and 4½
23	Built up to 120 C	15 min
	Held	1
	Released	30 min
24	150	1
25	Built up to 15	30 min
	Maintained at this temp. and 121 C	1
	Released	30 min
26	150	5
27	150	1
28	121 C	1–5
29	150	3
30	150	1
31	100	3
32	150	Various
33	150	1
34	100	3
35	150	1

References

(1) H. G. Schurecht, "Methods of Testing Crazing of Glazes Caused by Increases in the Size of Ceramic Bodies," *Journal*, Am. Ceramic Soc., Vol. 11, No. 5, pp. 271–277 (1928).

(2) H. G. Schurecht and G. R. Pole, "Effect of Water in Expanding Bodies of Different Compositions," *Journal*, Am. Ceramic Soc., Vol. 12, No. 9, pp. 596–604 (1929); *Ibid.*, Vol. 13, p. 369 (1930).

(3) E. P. Wright, "A Study of the Absorption of Two Earthenware Bodies and Their Resistance to Crazing in Steam Test," *Journal*, Am. Ceramic Soc., Vol. 12, No. 2, pp. 118–122 (1929).

(4) J. A. Callcott, "Notes on the Crazing of Lead Glazes on Earthenware Bodies," *Transactions*, Ceramic Soc., England, Vol. 13, pp. 49–55 (1913–1914).

(5) R. F. Geller and A. S. Creamer, "Moisture Expansion of Ceramic Whiteware," *Journal of Research*, Nat. Bureau Standards, Vol. 9, No. 2, September, 1932, p. 291 (*RP472*).

(6) R. G. Mills, "The Use of the Autoclave in Testing Ceramic Products for Resistance to Crazing," *Journal*, Am. Ceramic Soc., Vol. 13, No. 12, pp. 903–914 (1930).

(7) H. H. Holscher, "Expansion of Ceramic Bodies by Liquid and Vapor Penetration," *Circular No. 22*, Eng. Exp. Sta. Ohio State University (1931); *Journal*, Am. Ceramic Soc., Vol. 3, pp. 207–218 (1931).

(8) C. C. Treischel, "Moisture Expansion Tests," *Ceramic Age*, Vol. 25, No. 2, pp. 46–48 (1935).

(9) D. Hagar, "Effect of Tremolitic Talc in Whiteware Bodies," *Journal*, Am. Ceramic Soc., Vol. 19, No. 1, pp. 14–23 (1936).

(10) H. B. Schurecht and G. R. Pole, "Moisture Expansion of Glazes and Other Ceramic Finishes," *Journal of Research*, Nat. Bureau Standards, Vol. 6, No. 3, March, 1931, pp. 457–463 (*RP288*); *Journal*, Am. Ceramic Soc., Vol. 14, No. 4, pp. 313–318 (1931).

(11) O. G. Burch, "Some Observations on the Action of Steam on Glass," *Journal*, Am. Ceramic Soc., Vol. 18, p. 233 (1935).

(12) J. H. Koenig, "Physical Properties of Commercial Dinnerware," *Bulletin 101*, Eng. Exp. Sta., Ohio State University, May, 1939, p. 10.

(13) John Marquis, "Cone 01 Glazes for Low-Temperature Vitreous Ware," *Journal*, Am. Ceramic Soc., Vol. 27, pp. 359–364 (1944).

(14) R. L. Cook and C. D. Brunner, "Correlation of Glaze-Body Stresses with Thermal Properties of Whiteware Bodies," *Journal*, Am. Ceramic Soc., Vol. 32, No. 12, pp. 401–408 (1949).

(15) L. Mattyasovszky and Zsolnay, "Autoclave Test Results on Crazing of Sanitary Ware and Wall Tile," *Journal*, Am. Ceramic Soc., Vol. 29, No. 7, pp. 203–204 (1946).

(16) D. G. Moore and W. N. Harrison, "Tests for Hot Water Resistance," *Journal*, Am. Ceramic Soc., Vol. 30, No. 7, pp. 220–226 (1947).

(17) H. J. Orlowski and John Marquis, "Lead Replacements in Dinnerware," *Journal*, Am. Ceramic Soc., Vol. 28, p. 347 (1945).

(18) F. Burnham and M. A. Tuttle, "Influence of Variable Amounts of New York Talc, Flint, and Calcined Clay on Serviceability of Glazed Cooking-Ware Bodies," *Journal*, Am. Ceramic Soc., Vol. 28, p. 75 (1945).

(19) A. Herman and H. L. Shay, "Effect of Glass on Alcoholic Products Stored in Bottles at Room Temperatures for Three Years," *Journal*, Am. Ceramic Soc., Vol. 27, p. 54 (1944).

(20) H. Thiemecke, "Notes on Moisture Expansion," *Journal*, Am. Ceramic Soc., Vol. 27, p. 556 (1944).

(21) H. G. Schurecht, "Fitting Glazes to Ceramic Bodies," *Journal*, Am. Ceramic Soc., Vol. 26, p. 96 (1943).

(22) W. E. Palmer, "Influence of Flint Particle Size on Permanent Moisture and Thermal Expansion in Porous Earthenware Bodies," *Journal*, Am. Ceramic Soc., Vol. 25, p. 414 (1942).
(23) J. S. Owens and H. C. Emanuel, "Variable Factors in Accelerated Autoclave Chemical Durability Tests," *Journal*, Am. Ceramic Soc., Vol. 25, p. 143 (1942).
(24) J. H. Koenig, "Properties of Ware *versus* Thermal History: II Tests on Semivitreous China Bodies and Ware," *Journal*, Am. Ceramic Soc., Vol. 25, p. 45 (1942).
(25) A. Herma, "Factors Influencing Autoclave Tests of Glass Containers," *Journal*, Am. Ceramic Soc., Vol. 24, p. 323 (1941).
(26) R. F. Geller, and A. S. Creamer, "Notes on Moisture Expansion of Ceramic Whiteware in Storage and in Service," *Journal*, Am. Ceramic Soc., Vol. 24, pp. 77–79 (1941).
(27) W. C. Bell, "Evaluation of Glaze Fit Test Methods," *Journal*, Am. Ceramic Soc., Vol. 23, p. 166 (1940).
(28) F. R. Bacon and O. G. Burch, "Resistance of Glass Bottles to Neutral Alcoholic Solutions," *Journal*, Am. Ceramic Soc., Vol. 23, p. 147 (1940).
(29) E. H. Lintz, "The Use of Talc and Pyrophyllite in Semivitreous Dinnerware Bodies," *Journal*, Am. Ceramic Soc., Vol. 21, p. 229 (1938).
(30) A. M. Blakely, "Life History of a Glaze: II Measurement of Stress in a Cooling Glaze," *Journal*, Am. Ceramic Soc., Vol. 21, p. 249 (1938).
(31) J. W. Hepplewhite, "The Effect of ZrO_2 and TiO_2 Upon the Resistance to Crazing of a Typical Glaze for Semivitreous Dinnerware," *Journal*, Am. Ceramic Soc., Vol. 20, p. 61 (1937).
(32) W. C. Rueckel, "Factors Involved in the Production of Glazed Brick by the Dry-Press Process," *Journal*, Am. Ceramic Soc., Vol. 17, p. 12 (1934).
(33) C. L. Thompson, "Notes on Some Effects of the Variety of Flint Used on the Properties of a Hotel China Body," *Journal*, Am. Ceramic Soc., Vol. 17, p. 269 (1934).
(34) C. L. Deeds, "The Resistance of Single Clay Bodies to the Action of Steam," *Journal*, Am. Ceramic Soc., Vol. 14, p. 770 (1931).
(35) J. O. Everhart, "Some Simulative Tests for Glazed Building Materials," *Journal*, Am. Ceramic Soc., Vol. 13, p. 404 (1930).

Additional References

Anon., "Defects in Pottery Bodies and Glazes," *Ceramic Industry*, Vol. 18, No. 4, pp. 242–245 (1932); Anon, "Effect of Prolonged Boiling, Autoclave Treatment, and Drying on the Water Absorption of Earthenware," *Journal*, Franklin Inst., Vol. 211, p. 515 (1931); Anon., "Testing Glazes," *Ceramic Age*, Vol. 14, No. 5, pp. 179–184 (1929); J. W. Cobb, "Note on Disintegration by Crystallization and Freezing" *Transactions*, Am. Ceramic Soc., Vol. 11, p. 65 (1909); G. Keppeler and R. Pangels, "Swelling of Whiteware Bodies," *Sprechsaal*, Vol. 66, No. 37, pp. 625–628 (1933); H. Killias, "Contribution to the Question of Autoclave Testing on Earthenware Wall Tile," *Berichte der deutschen keramischen Gesellschaft*, Vol. 14, No. 6, pp. 243–257 (1933); J. M. Kregar, "Importance of Control of Body Mixture as a Preventative of Crazing." *The Ceramist*, Vol. 6, pp. 561–564; J. W. Mellor, "Crazing and Peeling of Glazes," *Transactions*, Ceramic Soc., England, Vol. 34, pp. 1–112 (1935); R. Pangels, "Swelling of Whiteware Bodies," Dissertation, Hannover (1934); F. K. Pence, "Crazing Test for Wall Tiles," *Transactions*, Am. Ceramic Soc., Vol. 18, p. 622 (1916); C. Ranche, "Cause of Defects and Their Cure," *Keramische Rundschau*, Vol. 44, No. 4, pp. 37–38 (1936); E. C. Stover, "Delayed Crazing and Shivering," *Transactions*, Am. Ceramic Soc., Vol. 11, p. 8 (1909); and "Crazing—An Abstract Review of Some of the Literature Dealing with Crazing of Ceramic Ware," *Ceramic Paper No.* 16, The Euston Lead Co.

Motor Mount Testing Machine*

By Lloyd Muller[1]

In any vibration problem the two controlling factors are frequency and damping. A familiar example is the use of springs and shock absorbers to obtain the riding characteristics of the present-day automobile; the chassis springs determine the frequency of the ride and the shock absorbers and interleaf spring friction control the amplitude of the ride.

Although more effort has been expended in preventing road roughness than in preventing engine roughness from annoying the passenger the attack on both problems has been along identical lines.

In the first wagons, which had no springs, riders received the full effects of the road roughness and in the early cars they were annoyed by the roughness resulting from "solid" installation of the engine. The first step in eliminating road roughness was the introduction of a spring between the road and the passenger and the first step in elim-

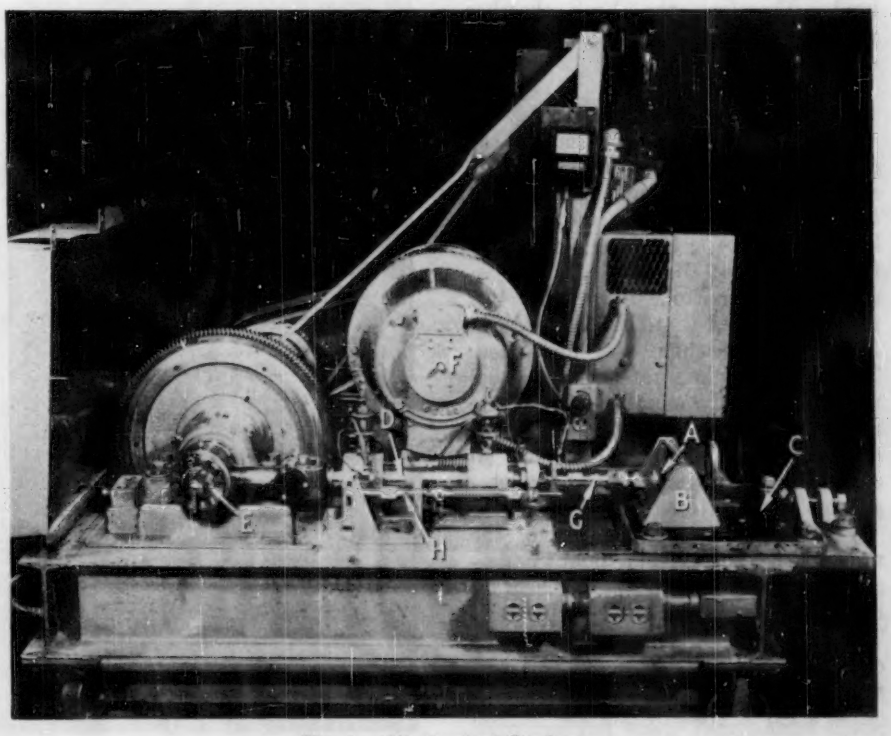


Fig. 1.—Mechanical Stroker.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at a meeting of Subcommittee XXVII on Tests of Resilience of Committee D-11 on Rubber and Rubber-Like Materials at Cincinnati, Ohio, March 8, 1951.

[1] Staff Engineer, Buick Motor Div., General Motors Corp., Flint, Mich.

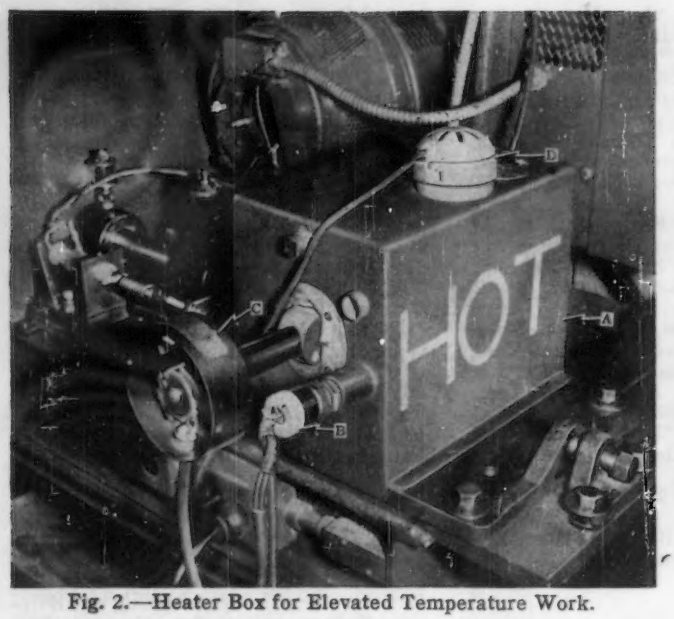


Fig. 2.—Heater Box for Elevated Temperature Work.

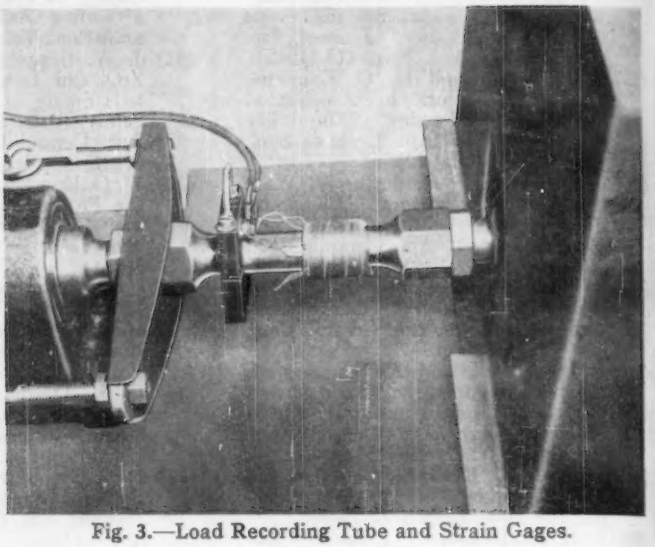


Fig. 3.—Load Recording Tube and Strain Gages.

inating engine roughness was to use a spring—usually rubber in the form of a motor mount—between the engine and the passenger. From this we can see that the initial step in each case was the frequency approach.

After reaching the frequency stage, most motor mount development stopped, but ride work progressed into the damping phase of the problem. It was found that the ride became better as the frequency lowered, but as the frequency became lower, the amplitude became larger and at resonance was uncontrollable unless some form of damping was used. Therefore, the shock absorber was developed and used to control the amplitude of the ride.

Description

A practical method of damping the engine's amplitude of motion became available with the commercial production of synthetic rubber of the high hysteresis type. However, this new factor presented the problem of measurement and control. It was with this problem in mind that the Buick Motor Mount test machine was developed. The hysteresis and rate of an actual mount under dynamic conditions are recorded. Basically the machine is composed of a mechanical stroker, an electronic strain recorder, and a photographic recorder.

Figure 1 is a close-up view of the mechanical stroker. The mount undergoing test is located at *A* and is held by bracket *B* which is bolted to plate *C*. This plate can be adjusted to give the desired preload on the mount or test sample. Movement of the mount in either shear or compression and tension loading is actuated through the reciprocating rod *D* by means of the crank at *E*. The machine is belt driven by motor *F*. Loads applied to the mount are measured by means of SR-4 strain gages cemented to load-recording tube *G*. The corresponding stroke is obtained by strain gages on stroke recording tube *H*.

Figure 2 shows the heating box used in elevated temperature work. The asbestos-lined heating box *A* is equipped with a heating element *B*, automatic temperature control *C*, and electric fan *D*. Temperature measurements are made at a point 1 in. from the mount being tested. At the endurance temperature of 100 F control can usually be maintained within ±5 deg without applying heat. When higher temperatures are required, the automatic temperature control *C* is set for the desired temperature and the bimetal thermostat regulates the temperature in the box through the heating element. In order

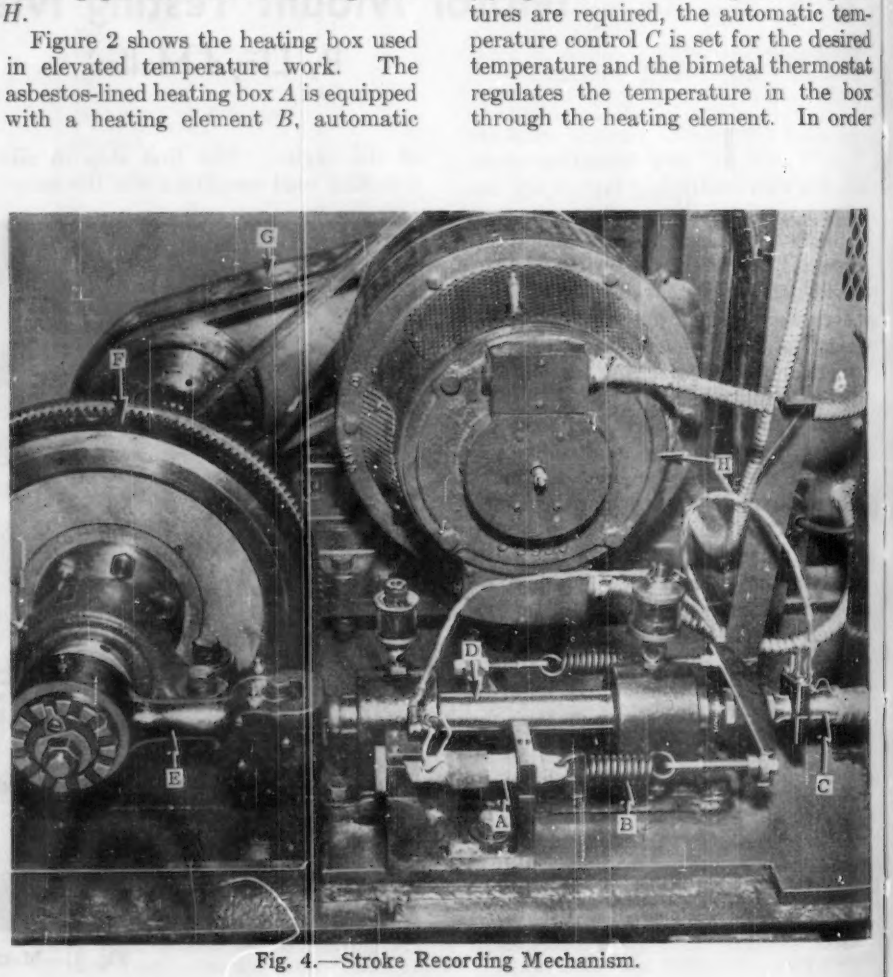


Fig. 4.—Stroke Recording Mechanism.

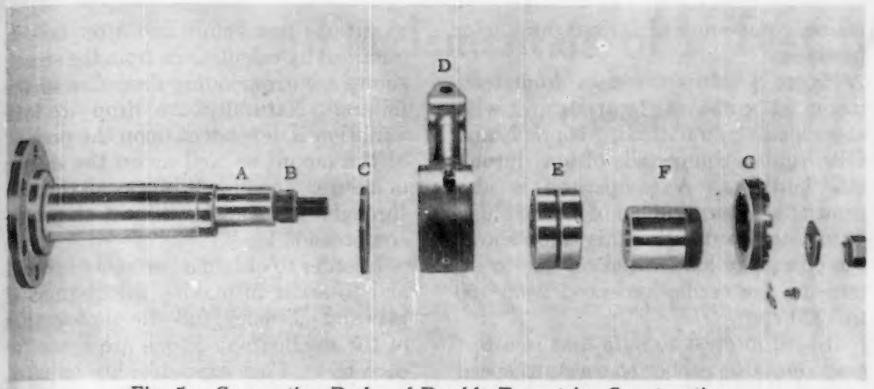


Fig. 5.—Connecting Rod and Double Eccentrics Construction.

to maintain uniform air temperature surrounding the mount, the fan is operated on all tests. A shield is used to prevent heat or other rays from the heating element striking the rubber in the mount.

The load-recording tube is shown in Fig. 3 with strain gage wires connected to the amplifier lead wires. This tube is made from steel of known modulus of elasticity and has a very thin wall. For a test having low loads, a tube of 0.040 sq in cross-sectional area is used. Four strain gages connected in series are used to eliminate the possibility of errors from slight bending that might occur due to uneven loading, particularly when a mount starts to fail on one side.

Assurance that strain gages are operating properly is quickly attained by means of a calibrating spring of known rate which is installed in place of the mount. As the spring rate is known, calculations from the strain gage data readily determine the accuracy of the strain gage readings. The actual stroke is measured by an indicator.

Whenever a strain gage or tube is replaced, a static test is made by applying known loads to the tube in either compression or tension using a Wheatstone Bridge to obtain the change in resistance of the strain gages. If the strain gages and tube are operating properly, the calculated and applied loads will be equal. If there is a discrepancy, the faulty gage can be quickly detected by testing each strain gage separately.

Figure 4 shows the stroke recording tube *A* and operating mechanism. A spring is introduced between the tube and the drive rod as the tube will not stretch as much as the stroke imposed on the mount. Spring *B* is of a known rate. The stroke recording tube is similar to the load recording tube *C* except that it is necessary to have a slightly thinner wall section or a very high spring rate in order to give a satisfactory signal on the oscillograph. The reciprocating shaft *D* is driven through connecting rod *E*. To maintain uniform angular velocity throughout the operating cycle, a heavy flywheel *F* is mounted on the crankshaft. Wires connect the strain gages to the amplifier. A variable stroke is obtained by means of an eccentric located inside the large end of the connecting rod *E*.

Figure 5 is an exploded view of the eccentric and bearing assembly. The eccentric *F* fits on crank *A* and is held from turning by serrations at *B*. The variable stroke is obtained by rotating the eccentric for one or more serrations and can be changed from 0 to ½ in. stroke. *E* is a roller bearing which fits between the eccentric and connecting rod.

The load and hysteresis loop obtained through the strain gages as previously described is shown on an oscillograph which is connected to an amplifier. A power unit is used to supply current for the amplifier. In order to obtain the correct load readings, it is necessary to calibrate for various settings of the oscillograph controls. This is accomplished by means of breaker points operated by an electric motor.

Discussion of Results

Figure 6 illustrates a typical hysteresis loop obtained with GRS rubber. The horizontal and vertical axis represent the stroke and load variation imposed on the mount. The area enclosed in the loop is the work lost or damping present in the rubber. A scale is included in the photograph as a basis for

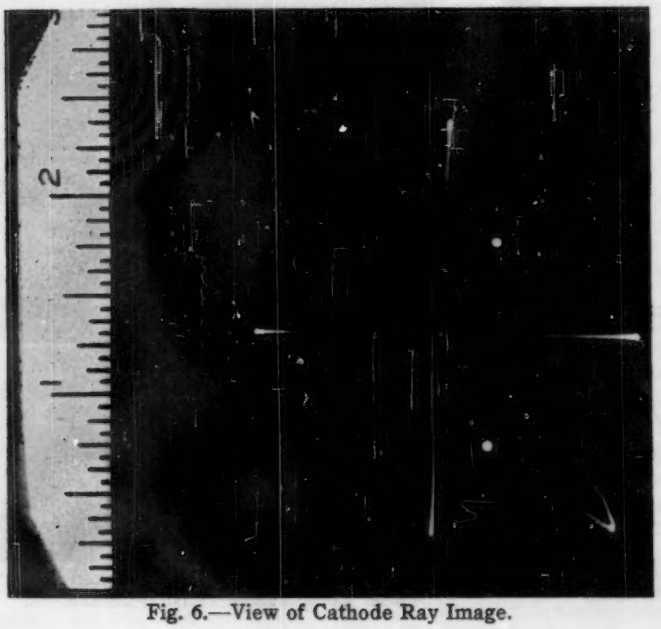


Fig. 6.—View of Cathode Ray Image.

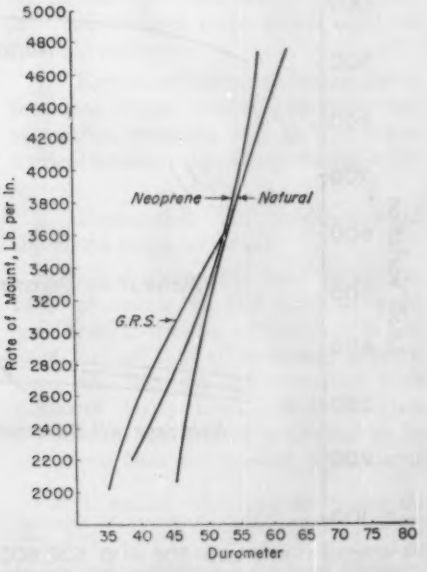


Fig. 7.—Durometer-Rate Comparison of GRS, Neoprene, and Natural Rubber at 1000 rpm and Room Temperature (Sheaf Loading).

determining if any distortion or magnification has occurred during the photographic process.

Three types of dynamic tests are made on the Buick testing machine: (1) constant speed tests; (2) constant temperature tests; (3) endurance tests. The endurance tests are run at constant speed of 750 cpm (cycles per min) and constant air temperature of 100 F. The three types of test can be made for both tension-compression and shear loading. Static tests can be made by measuring the applied load with a Wheatstone Bridge connected to the strain gages and the deflection with an indicator.

The graphs that follow indicate the results of tests that have been made on this machine. However, they can only be used as a rough guide, since the tests were run on compounds furnished by various rubber companies. The rate, modulus, or efficiency might vary from one company to another for the same durometer hardness.

Static load-deflection tests made on natural and synthetic rubber mounts of the same durometer hardness gave nearly a single line for natural rubber and a hysteresis loop for synthetic rubber. It was also found that for low durometer compounds and under static testing natural rubber has a higher modulus than GRS rubber, while under dynamic conditions GRS has the higher modulus.

Figure 7 shows a comparison of rate between natural, Neoprene, and GRS rubber compounds of various durometer hardness.

Figure 8 shows the data from tests made at constant temperature with sheer loading on natural, Neoprene, and GRS rubber compounds of low durometer hardness. A comparison is also shown for natural rubber of low and high durometer hardness. This chart shows the change in load variation due to increasing the oscillation speed from 150 to 1000 cpm.

It is of interest to note that in a test made on GRS rubber at constant speed of 750 rpm with compression-tension loading the rate decreased 28 per cent when its temperature was increased from 100 F to 200 F.

In a test made on butyl rubber at constant speed of 750 rpm with compression-tension loading, the efficiency increased with increase in temperature.

When a mount starts to fail, the failure is indicated by a change in the shape of the signal shown on the oscillograph. In Fig. 9, the mount had failed almost completely. It was tested with compression and tension loading with $\frac{1}{32}$ preload. That part of the signal to the left of the Y axis remained normal because this portion of the signal represents the compression loading. The signal leveled off to a horizontal line at the starting point of tension loading. When a mount has only a small internal break in the rubber, the signal will be distorted at the same point but to a lesser degree. A comparison of the load variations just before and after failure, obtained by calculations from the signal, shows a corresponding drop due to the failure. Naturally the drop in load variation is dependent upon the preload of the mount as well as on the degree of failure. If a mount breaks all the way through, the signal will still show the compression load.

In order to obtain a permanent record and to assist in making calculations of rate and efficiency, full-size photographs of the oscillograph image are made for each test. Four exposures are required to show the vertical and horizontal axis, the hysteresis loop, and the calibration dots. After these four exposures have been made a black cover with identification plate and scale is placed in front of and next to the glass in the oscillograph. Another exposure is then made with bright lights located on each side of the camera. With this procedure, each photograph can be readily identified with sufficient information for calculations without referring back to data sheets.

Acknowledgment:

The author wishes to acknowledge the cooperation and assistance of the General Motors Research Laboratories Division and of G. M. Rassweiler and his department in particular in designing and building the electronic equipment.

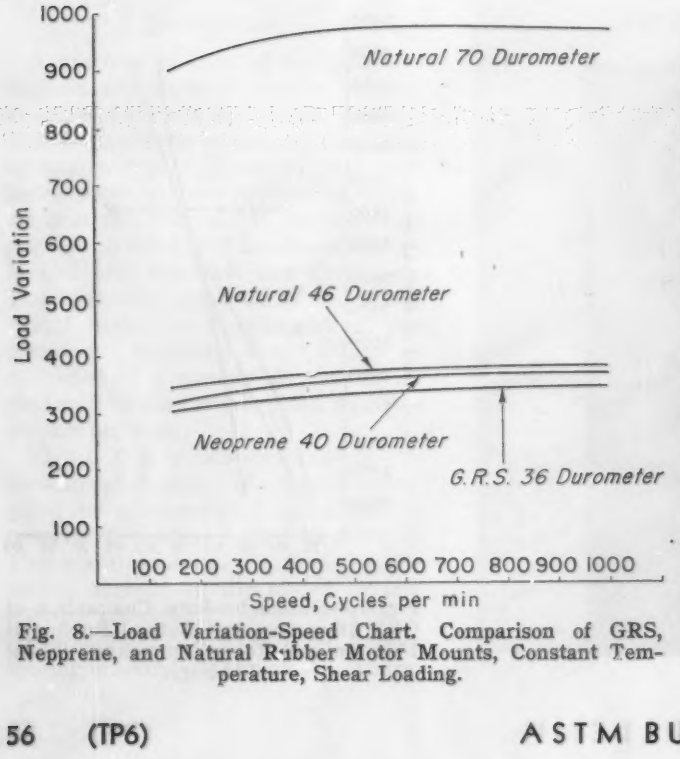


Fig. 8.—Load Variation-Speed Chart. Comparison of GRS, Nepprene, and Natural Rubber Motor Mounts, Constant Temperature, Shear Loading.

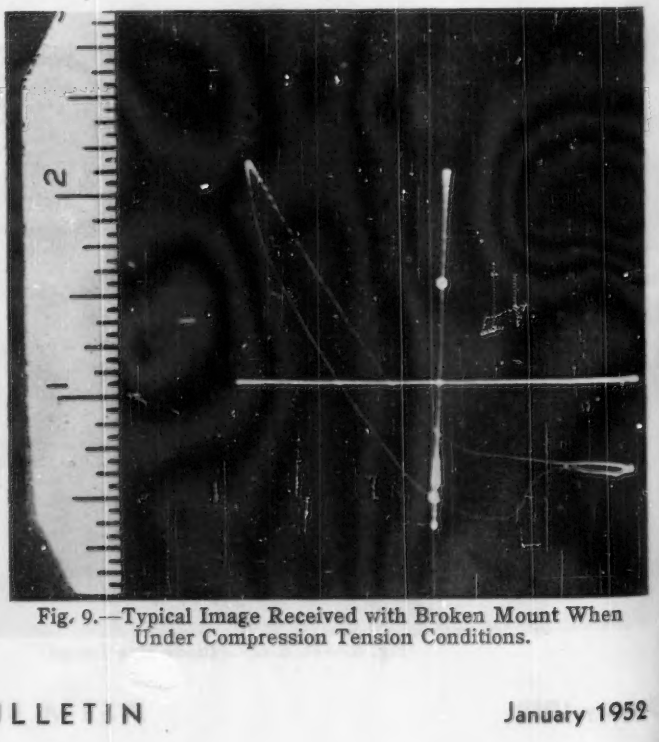


Fig. 9.—Typical Image Received with Broken Mount When Under Compression Tension Conditions.

Fundamentals of a Test Method

By Gilbert L. Peakes[1]

SUMMARY

When the need for a test method arises and when a test method is under consideration, the following steps should be taken:

1. Obtain a group of product units which have or are believed to have differences in the property to be measured. Such differences must be expressible numerically.

2. Apply the new test to these product units and derive the results in numerical measures. Include multiple measurements on each unit.

3. Compute the *F* ratio, which is variance of product divided by variance of test, and obtain its significance.

4. (*a*) If the *F* ratio is definitely not significant, change or abandon the test concept, or try it again on product units having larger increments of the tested property.

(*b*) If the *F* ratio is above or below but near the significant level, make more tests.

(*c*) If the *F* ratio is definitely significant, plot the values obtained by the test procedure against the values of that property (or its control) known of believed to exist in the product units.

5. When 4(*c*) appears to show a trend, test the significance of the trend by least-squares line or correlation techniques. If the trend is curved, rectify it before such test.

6. (*a*) If 5 shows the trend is significant, accept the procedure for a test as it stands, or continue refining it on a cost or speed basis, as the needs of the situation suggest.

(*b*) If 5 shows the trend is not significant, adjust or abandon the test concept.

7. If experimentation continues, a satisfactory test will be in hand when:

(*a*) The *F* ratio is significant.

(*b*) The correlation is significant.

(*c*) The cost is reasonable.

(*d*) The duration is acceptable.

8. If and when all the conditions of 7 are met, write the details of the procedure covering all necessary precautions and standardized conditions. Include a statement of the precision to be expected.

Most published discussions regarding the merits of specific test procedures cover either a study of why different operators or laboratories get different results with presumably the same procedure,[2] or a study of which one of several procedures is best when used in one or more laboratories.[3] It would seem that a basic step preliminary to such comparisons would be that of working up an idea for a test into something worthy of tryout in such comparisons, yet the author has been unable to find such publication and therefore offers the following ideas to those who must start with the bare concept of a "test" and work it up to the full dignity of a "testing procedure."

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Bakelite Co., Division of Union Carbide and Carbon Corp., Bound Brook, N. J.

[2] W. J. Youden, "Comparative Tests in a Single Laboratory," ASTM BULLETIN, No. 166, May, 1950, p. 48.

[3] G. Wernimont, "The Design and Interpretation of Interlaboratory Test Programs," ASTM BULLETIN, No. 166, May, 1950, p. 45.

DISCUSSION

In the continuous search made by ASTM committees for new tests and better tests, it frequently happens that two or more different proposals are made as methods for attaining similar information about quality. Proper conservatism requires that the committee concerned should examine the merits and demerits of each proposal and if possible make a choice to be recommended to the Society as a tentative method. The *Proceedings* and committee reports of the Society are replete with data obtained in such examinations, which often take the form of having each of several laboratories run the different proposals. The object is of course to arrive at the most useful and economical method, but the path to such a method is seldom traveled without finding that in carrying out the prescribed routines some serious sources of error have been overlooked.

In recent years statistical treatment of test data has come more and more to the front to aid in finding and appraising sources of error and in making objective comparisons of the values of several proposed methods. Means of making objective judgments about test methods by statistical criteria have been described by Youden for comparisons between methods[4] and between laboratories.[5] However, it happens only too often that one or more of the proposals being considered by an ASTM committee is found after trial by other than the proposer to contain poor choices of standard conditions or to omit mention of precautions necessary for consistent results.

Wernimont[6] states: "It is a waste of time to try to evaluate the precision and accuracy of a test method until it has been shown that the test method is reliable." Allowing incomplete or defective methods to enter a round-robin test is certainly an economic waste. The discussion below is directed to pointing out how a test method as originated in one laboratory may be examined there for internal integrity before becoming an entrant in a round-robin competition between different methods. This discussion is intended as a guide for the persons directly responsible for test development and should aid them in the development stages before their method is considered for comparison with methods from other sources.

The establishment of a new test procedure may be considered to be divided into two distinct steps which must be taken in order:

1. Experimentation to integrate a sequence of acts involving product, test apparatus, reagents, etc., so that a numerical measure of product quality is obtained.

2. Description and publication of the above sequence of acts.

Step 2 is reasonably easy to accomplish according to the rules of good specification writing, although it is unusual to find that all necessary precautions are included and described with sufficient clarity in the first draft. Step 1 seems to have been neglected as to assurance that the needed precautions

[4] W. J. Youden, "Technique for Testing the Accuracy of Analytical Data," *Analytical Chemistry*, Vol. 19, p. 946 (1947).

[5] W. J. Youden, "Multiple Factor Experiments in Analytical Chemistry," *Analytical Chemistry*, Vol. 20, p. 1136 (1948).

[6] G. Wernimont, "Precision and Accuracy of Test Methods," Symposium on Application of Statistics, Am. Soc. Testing Mats., p. 13 (1950). (Symposium issued as separate publication, *STP No. 105.*)

are mentioned and the necessary standard conditions are found and maintained.

Since different procedures in tremendous variety are used for testing, no generalized instructions can be given for the actual manipulations; however, it is possible to be rather specific about the ideas, concepts, and appraisals which will be useful in guiding the experimentation.

This discussion is based on the idea that a *factory* turns out a *product* which has to satisfy a *customer* and make a *profit*. The action starts with the customer, who orders, and the product shipped must satisfy him. He has means, say a "test," by which he recognizes whether the product satisfies him. The factory, in order to satisfy the customer, must make the same test, or some related test which accurately predicts the results he will get. To be sure of satisfying the customer, the factory must make its test a little more severe or more informative than the customer's, and keep it that way. Furthermore, in order to protect the factory's profit, the cost of the testing program must be considered at all times.

The cost of the testing program can be divided into two parts:

1. The direct cost of tests performed before shipment.

2. The indirect cost resulting from the failure to make tests before shipment, bringing about complaints, adjustments, and the actual testing, which usually turns out to be more elaborate per unit than that which would have been done before shipment.

There are two fundamental and inescapable facts which must be kept in mind by those trying to organize a sequence of acts so that such sequence may be called a "test." These are:

1. No sequence of acts arranged for use as a test will be completely reproducible; therefore there will always be some variability in the results of a test even when applied to a hypothetically constant product.

2. No sequence of units of product can be made completely uniform, therefore there will always be some variability in the results of testing a sequence of units of product.

A person must not at this point jump to the conclusion that it is hopeless to try to rate a variable product by a variable test. There are established methods for handling such situations so that the conclusions drawn after any test shall have a high probability of being correct. Sometimes these methods lead to a conclusion which says "insufficient evidence," but that is just as valid and valuable as the other kind.

From the above two fundamental facts it may be concluded that since the variability of a product can be appraised only by use of a test which has its own variability, test results which purport to appraise variability of product are always contaminated by variability of test. It follows that since the variability of test cannot be avoided it must be overcome, and the method of doing this is to adjust the conditions of the test so that its response to variables of product will be greater than its response to its own variables.

A good test may be devised only by keeping control of the significant variables involved. This means making the test *relatively* responsive to variability between units of product, and *relatively* inert to variability in its own operating conditions. Expressing these variabilities in the statistical measure called "variance," a test will be good for its purpose when the variables affecting it are controlled so that two things are done simultaneously:

1. The variance of test values which are repeated measures of constant product, is minimized.

2. The variance of test values which are measures of different units of product is maximized.

The proper balance between these two variances acting simultaneously is obtained by taking their ratio,

$$\frac{V(P)}{V(T)} = \frac{\text{Variance of Product}}{\text{Variance of Test}}$$

and when the conditions of the test have been so arranged as to make this ratio sufficiently large then and only then has a proposed new test been put into condition for judging whether its use is worth while. If the test cannot be adjusted so that this ratio is made large enough, the test will not be worth performing. The test will also not be worth performing if it costs too much, if it measures something other than the *desired* property, or if its duration is so long that the values are not usable as guides at the time they are ready.

There is, of course, some computation involved in the expressions "Variance of Product" and "Variance of Test." It is assumed the reader either has some knowledge of statistical methods, or that he will obtain any needed help from suitable texts, such as Snedecor,[7] Brownlee,[8] or Davies.[9] Numerical examples will be given later.

The ratio of the two variances is called F, and tables of standard values of F are available.[7,8,9] Assume that the development of a test goes forward in steps, each of which is tested by a determination of the F ratio, followed by a subsequent retrial of the test under new conditions in an attempt to increase the ratio. The question now arises as to how to know when the F ratio has become large enough. Such decision is reached by comparing the computed ratio with the values required for significant levels as given in the F table. Computed values as high as or higher than the tabulated one are taken to mean that the tabular value of significance has been reached or exceeded. Since the variance of test is always present when the variance of product is computed, it will be evident that when the F ratio is computed for supposedly different product units, it will tend to approach 1 as a minimum, and its maximum can be a large number. The F test as applied here not only shows *whether* a test is delicate enough to distinguish the desired differences, but, what is frequently of importance to costs, it shows at what point the experimental work may be safely and confidently stopped because the test method has now become sufficiently delicate.

In devising a test procedure it is fundamental that the over-all purpose is to measure differences between units of product. If these differences are large, a crude test will suffice for rating them; if they are small, a refined test is required. The variance ratio as indicated above serves to put the two kinds of variances into proper balance. Whenever in the course of refining a test method the variance ratio reaches a statistically significant level, it may be judged that the method is now sufficiently sensitive for the purpose in hand. However, it is necessary to make sure, or be as sure as possible, that the "purpose in hand" has been correctly appraised.

If the premise is accepted that the purpose of a test is to discover differences between units of product, then a study of test conditions confronts the experimenter with detailed choices as to what are the differences of product which are to be distinguished. Ordinarily a test will be devised so that it will distinguish the differences between successive units of the same product, and if it will do that, it will usually be adequate for distinguishing between units of different products, if that becomes necessary to do by test. According to the details of a given program, "successive units" may at times mean successive samples from one product unit.

At the beginning of devising a test, there is no evidence that any units of product differ by such a test because such a test does not exist. It is necessary therefore to begin by trying the early concept of the new test procedure on a group of product units which either have been demonstrated as different by

[7] G. W. Snedecor, "Statistical Methods," Iowa State College Press (1946).
[8] K. A. Brownlee, "Industrial Experimentation," Chemical Publishing Co., Brooklyn, N. Y. (1947).
[9] O. L. Davies, "Statistical Methods in Research and Production," Oliver and Boyd, London (1947).

a customer's use, or which have been made for test-evaluation purposes by known adjustments of the product which (it is believed) will affect the numerical results of the contemplated test procedure.

At the beginning of a test development program, when little is known about the efficiency of the contemplated procedure as a test for measuring differences of product, it is advisable to apply the procedure to product units which are known or expected to differ widely in the property to be measured. If it is then found that the procedure does not give measures which seem to correlate with the known or expected differences, the procedure may be quickly changed or abandoned. If the procedure does show the type of relation expected, then a group of product units containing smaller increments of quality difference may be selected or made up for use in further refining the procedure.

Assuming that some arbitrary choice of conditions of test is made and used on the chosen set of product units, it will be required that the test be performed no less than twice on each product unit. This repetition is needed for getting the variance of the test as such. Since the test variance may change as the level of test results changes from one product unit to another, it is not satisfactory to make all the repeat tests on the same product unit. The test method is now "tested" by computing the F ratio and finding its significance from the table. If the F value is at or higher than the 5 per cent significance level, it may be concluded with 95 per cent confidence that the differences in the product units can be distinguished by the test. If the F value is lower than that, it is evident that under these conditions the test cannot reliably measure the product differences. Since the F value obtained is the quotient of two *estimates* of true variance, each of which may differ from its true value by the vagaries of sampling, any F value which is near the decision boundary of 5 per cent probability should be confirmed by more measurements before making or abandoning further adjustments of the procedure.

The computations required are indicated in the following example of data, taken to compare two supposedly different lots of product for a reaction time. All readings in each column are independent of each other and of the readings in the other column.

REACTION TIME, SEC

Lot No. 1	Lot No. 2
75	77
77	80
76	78
79	80
78	81
79	79

The computations are shown below:

	x_1	x_1^2	x_2	x_2^2
	75	5 625	77	5 929
	77	5 929	80	6 400
	76	5 776	78	6 084
	79	6 241	80	6 400
	78	6 084	81	6 561
	79	6 241	79	6 241
Sum...	464	35 896	475	37 615
Avg....	77.33		79.16	

For Lot No. 1 the variance of test is calculated from the formula:

$$V(T) = \frac{n\Sigma x_1^2 - (\Sigma x_1)^2}{n(n-1)}$$

as

$$V(T_1) = \frac{6 \times 35{,}896 - 464^2}{6 \times 5} = \frac{80}{30} = 2.66$$

For Lot No. 2,

$$V(T_2) = \frac{6 \times 37{,}615 - 475^2}{6 \times 5} = \frac{65}{30} = 2.16$$

The average of the two estimates is

$$\frac{2.67 + 2.17}{2} = \frac{4.84}{2} = 2.42$$

and this is the estimate of test variance $V(T)$.

(The squared individual readings in each group are needed only as a sum which may if desired be obtained by cumulation on a calculating machine.)

The estimate of variance of the product is obtained as:

$$V(P) = \frac{(\Sigma x_1)^2}{n} + \frac{(\Sigma x_2)^2}{n} - \frac{(\Sigma x_1 + \Sigma x_2)^2}{2n}$$

$$= \frac{464^2 + 475^2}{6} - \frac{939^2}{12} = \frac{44{,}0921}{6} - \frac{881{,}721}{12} = 73{,}487 - 73{,}477 = 10$$

The ratio of variances is:

$$F = \frac{V(P)}{V(T)} = \frac{10}{2.42} = 4.13$$

The value which the F table gives at the 5 per cent level for a problem of these dimensions is 4.96, and since the computed value is near but less than the tabular figure, it would be in order to take more data on the present test setup before attempting further refinements. If variances obtained in the repeat tests do not differ from the original variances by inconsistent amounts, the evidence from both sets of data may be pooled together to produce a more reliable estimate of F.

It should be obvious that 2 lots of product are ordinarily not sufficient to see how well the test survives the hazards of product variation. That is a matter for engineering judgment applied to the type of product tested. The two lots cited represent merely an example to show calculations, which will be made according to similar principles for any number of product units and any number of tests per unit.

Assuming that the development of a test method proceeds until a satisfactory F ratio is attained, the process of devising the best procedure for the test is not yet finished. The significant F ratio means that the test is sensitive to *something* which is different between the product units, but the test values may be responding to product differences which are not at all the ones intended to be measured. Suppose the units of product tested were made up containing adjustments put in for the purpose of test development. It may well happen that the intentional differences are not as effective as expected in influencing test results, but that some uncontrolled factor influences the test values in a manner different from and perhaps more strongly than the intentional differences. If this happens, the F ratio may have a significance which is false because it rates an effect entirely different from the one intended to be rated. To avoid this possible error, an examination of the test results must be made to see whether they correlate with the known differences or adjustments of product which it was hoped to measure. If the values measured by the test show, when plotted, some kind of a trend with the known or intended differences, then the evidence of significance by the F test may be accepted as useful in the present case. Significance of the trend seen in plotting may be judged by the methods of least-squares, straight lines, or of the correlation coefficient. Both are explained in the reference texts. If the trend line is curved, the data should be transformed to some function which rectifies the line before applying these methods.

As a further example of data to be handled by this technique, consider the following figures obtained for the purpose of finding out whether a test for per cent reflectance would be an adequate measure of the changes in surface quality of a plastic, which seemed to deteriorate with increased processing time. Five samples were made up at each of four equally spaced intervals of processing time and reflectance readings taken as follows:

Time, arbitrary units...	Reflectance, per cent			
	1	2	3	4
	80	33	65	50
	78	45	65	60
	80	33	64	46
	85	36	70	59
	78	40	63	55
Total..	401	187	327	270
Avg....	80.2	37.4	65.4	54.0

The simple F ratio obtained in the previous example is less simple to compute this time, and it seems best to prepare the data to go into a formal table of analysis of variance. The principles and procedure are explained by Snedecor,[7] and the computations follow:

Grand sum of all observations, $401 + 187 + 327 + 270 = 1185$

$$\frac{(\text{Grand sum of all observations})^2}{\text{Total number of observations}} = \frac{1185^2}{20} = 70{,}211$$

Sum of squares of all observations, $80^2 + 78^2 + \text{etc.} = 75{,}429$

$$\frac{\text{Sum of squares of column totals}}{\text{Number of observations per column}} = \frac{401^2 + 187^2 + \text{etc.}}{5} = 75{,}120$$

ANALYSIS OF VARIANCE

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares
Total.....	75,429 − 70,211 = 5218	20 − 1 = 19	$\frac{5218}{19}$ = 275
Between columns...	75,120 − 70,211 = 4909	4 − 1 = 3	$\frac{4909}{3}$ = 1636
Within columns....	5 218 − 4 909 = 309	19 − 3 = 16	$\frac{309}{16}$ = 19.3

The F ratio required is the "Between Columns" mean square divided by the "Within Columns" mean square, equal to:

$$\frac{V(P)}{V(T)} = \frac{1636}{19.3} = 84.8$$

This value when referred to the F table is found to be much higher than that required for significance, and therefore one may conclude that the differences of reflectance between these samples are with a very high probability real and distinguishable in spite of the variability of the test method.

Examination of the averages discloses that the trends between successive increments of time are down-up-down, and although the series ends lower than it began, there may be some doubt as to whether the down-trend is dependable. The statistical test for this is also given by Snedecor,[7] and when carried out it shows that the down-trend is not significant. Therefore it is necessary to conclude that, although the test in this case distinguishes adequately between the samples, its result seems to be pointing out something other than the effect of the time adjustments.

This type of behavior is similar to that which could be obtained by switching sample markings or making data entries in the wrong column. If these possibilities are checked and ruled out, the next step would be to look for a cause of reflectance influence which is different from the processing-time adjustment actually used.

In general, once it has been established that the test in its present crude form really measures the desired property, it is necessary to go further and try to make sure that the results of the test as such shall not be disturbed by changes in test conditions. Types of variables whose effects are sometimes originally neglected and then recognized only after bitter experience are:

1. Operator.
2. Time of day.
3. Barometer.
4. Humidity.
5. Lighting.
6. Temperature (of product, of test equipment, etc.).
7. Reagents.
8. Equipment differences.
9. Preparation techniques.
10. Delays.
11. Many miscellaneous factors.

It is of course not necessary that every job of test method development should be expanded to the point where all the sources of possible error are completely evaluated. In some instances, a little reasoning will eliminate work on some of them. In other instances, a quick crude check will eliminate others. In every case, however, it is necessary to consider the possibilities and be guided by one's reasoning power as to what evaluations of possible test disturbance will have to be made. Experience has shown that it is fatuous to proceed with a test method until such studies have been made, and until statistical comparisons such as those described have justified the use of the test for the purpose proposed. Methods which are to be submitted for tryout by ASTM committees should certainly receive critical examination before submission.

It is common experience to find that a test of long standing, one which presumably would by now be well refined, gives a satisfactory set of readings on a product unit today, and tomorrow gives another set of readings on the same product unit, which look equally satisfactory within the set but which give a startling difference between the averages. One way to describe this condition is to say that the long-time variability is larger than the short-time variability—some uncontrolled variable stayed fairly constant within each group of tests but swung widely between tests. In considering a new test, such a condition should at least be known even if it cannot be removed.

A condition of this sort still prevails in many tests which are routine, and while that condition prevails it is imperative that a "blank" or "control" be run as part of every new measurement. This is very expensive when applied to a large volume of testing work. If the test could be completely trusted, the "controls" of many experiments could be omitted. Statistical methods are available for obtaining a variance which measures long-time variability of a test, and such a variance must be used for the F ratio whenever the long-time variance is found significantly larger than the short-time variance.

The type of instruction in experimentation which has been given to many technical graduates takes for granted that in any measurement operation, all sources of variability are to be controlled, and this point of view permits the easy but erroneous conclusion that any careful set of measurements will give correct values. Industrial experience belies this, because a technician can control no more variables than he knows about, and many times a powerful source of variability goes unrecognized. Once the all-pervading nature of variabilities is recognized, a technician can not only live with them but make good use of them besides. Fluctuations in numerical measurements should not be regarded as disturbances which partially or wholly vitiate the results, but as a source of information about the precision of the measurement.

There are two ways in which fluctuations of the last significant figures of a series of repeat measurements can add to the certainty of numerical conclusions. The first is, that if the test apparatus is not being read to its maximum precision, there will be a predominance of readings which are alike including the last significant figure of the reading. If substantially more than 10 per cent of such repeat readings are identical, it is almost certain that the apparatus is not being read to its maximum precision.

The second way in which fluctuations of the value can add to the certainty is that they may be used to calculate a measure of the precision. If the fluctuation is not computed and used, the precision must be guessed at; if it is used, the precision is numerically estimated and the estimate contains an allowance for the error of estimating.

The variance ratio when applied in the manner suggested here is a measure of the sensitivity of a test in disclosing product differences. When it is significant, progress can be made in studying and perhaps increasing product uni-

formity. Improvements in product uniformity will reduce the numerator of the F ratio, and if such product improvement carries the ratio down to an insignificant value, no more progress toward product uniformity can be appraised until the test variance is reduced, thereby bringing the ratio up again to a value at which the test sensitivity is significantly shown. This means that routine tests should be periodically reappraised, not only to make sure that their precision has not deteriorated, but also to keep their precision progressing toward that needed for appraisals of current product.

To every procedure tried out and proposed as a test, one final touch of value should be added, and that is a statement of the precision to be expected. Such statement of precision is preferable in terms of confidence limits, and for details of this, texts such as Snedecor[7] are again the reference. The value of being able to set confidence limits may be illustrated by a very simple and very common situation. Two units of product are measured, by a sequence of acts which are hoped and believed to constitute a "test." The "test" shows different numerical values for the two units. The confidence limits on these values or on their difference will disclose one or the other of two clear situations:

1. There is evidence that the units are probably different, or
2. There is no evidence that they are different.

Case 1 provides information on which further experimentation may be based, or on which changed manufacturing may proceed.

Case 2 provides justification for either: (*a*) gathering more data, or (*b*) proceeding with experimentation or manufacture knowing that the real difference between the product units is negligibly small.

Conclusions

For those who are concerned with making a product within a cost figure, and simultaneously holding its quality at a customer-satisfying level regardless of what quality the competitors offer, this paper tries to provide a reliable foundation of knowledge about how to tell whether a proposed new test will really help in making the right quality decisions. The discussion above should also be of some benefit to the technician who would be embarrassed if serious flaws in his pet testing procedure should be turned up in a round-robin comparison of test procedures.

The Notch Toughness Test of Henri Schnadt

By Wendell P. Roop[1]

Maxwell Gensamer and his associates at Pennsylvania State College, in their search for a laboratory test of notch toughness which would give reliable warning of the lack of it in large models and in assembled working structures, made good use of a type of specimen then new in the United States, that of Henri Schnadt (1).[2] It resembles a Charpy specimen, but the material under compression is removed in such a way that fracture occurs in tension, which is only moderately eccentric. Gensamer's earliest knowledge of Schnadt's work came, via *Engineers' Digest* of March, 1947, from an article by Schnadt in *De Ingenieur*, December 13, 1946. In May, June, and July 1950, appeared a series of articles by J. H. Palm (2) which greatly clarify the presentation of Schnadt's ideas. This is thus a suitable moment for evaluation of those ideas.

Schnadt himself (3) in discussion of Gensamer's paper, gave a résumé of his thought on this subject, but in coined and undefined words that left the American reader unenlightened. The successful use of his specimen at Pennsylvania State College was dissociated from Schnadt's theoretical considerations. Similar success was had in tests at the Fritz Laboratory (4), although for reasons of convenience it was decided to adhere, for tests at that laboratory, to the Lehigh plate bend test developed there.

M. Schnadt lectured in London on Nov. 30, 1950, and notes made then by Finn Jonassen were transcribed and circulated on his return home. But Palm's account of Schnadt's theories is the best available and it provides the basis for the following comment.

The basic concept is that of "plastifying power" (tension plastonique), designated π; it is the quotient of effective (or significant, or octahedral) shear stress τ divided by the greatest principal stress σ_1, but with a numerical coefficient such that

$$\pi = \sqrt{1 + n_2^2 + n_3^2 - n_2 - n_3 - n_2 n_3}$$

where

$$n_2 = \frac{\sigma_2}{\sigma_1} \text{ and } n_3 = \frac{\sigma_3}{\sigma_1}$$

In uniaxial tension $n_2 = n_3 = 0, \pi = 1$. In balanced biaxial tension, $n_2 = 1$, $n_3 = 0$, $\pi = 1$. In balanced triaxial tension $n_2 = n_3 = 1, \pi = 0$. π is, in effect, a measure of triaxiality but one which differs in important respects from that current in the United States. The two concepts are complementary since full triaxiality corresponds to zero value of π, and the lowest value of triaxiality in the absence of compressive action corresponds with unity value for π.

The commonest measure of triaxiality in the United States is that seen in the numerous papers of George Sachs (5), namely, the ratio of the lowest to the highest of the three principal stresses, designated by Sachs k and by Schnadt n_4. This convention is especially useful when $\sigma_2 = \sigma_3$, as on the axis of a tension test specimen bounded by a surface of revolution, since in this case $\pi = 1 - k$. k thus gives a direct rather than an inverse measure of triaxiality; however it is not affected by variation in σ_2 and its general use presupposes that σ_2 is not significant. Whether this is true is a question of fact not yet fully answered, but certainly we may not simply ignore it. At the same time when we adopt π as the measure we make a rather specific assumption, namely, that the condition $\sigma_2 = \sigma_3$ is equivalent to the condition $\sigma_2 = \sigma_1$. For intermediate values of σ_2, π has the merit of giving a consistent measure, with a simple geometrical interpretation, of triaxiality which also extends to the full range of variation of both stress ratios. In this it goes beyond the U. S. measure. The effect of n_2 on π is not

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Anchorage Farm, Sewell, N. J.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

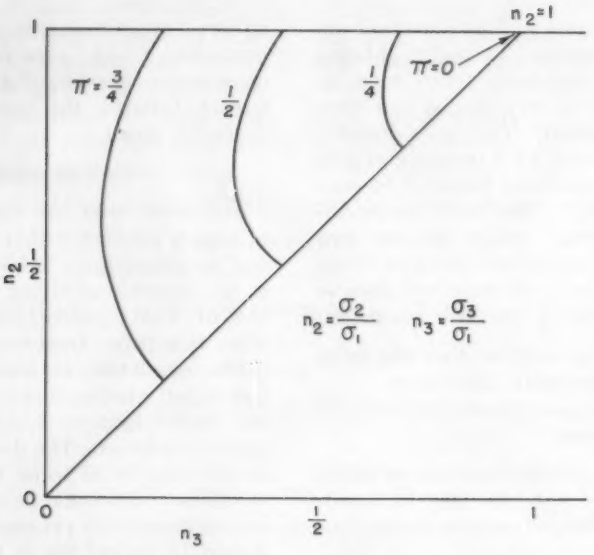


Fig. 1.—Contours of Complementary Triaxiality π on Stress Ratios n_2 and n_3.

very great, consisting in a reduction, at most, of 13.4 per cent when $n_2 = (1 + n_3)/2$, under the equal values when $n_2 = 1$ and $n_2 = n_3$.

The quantity π is related in an important way with the absorption of energy in plastic flow. Supposing, as in my earlier paper (6), that the material has a stress-strain curve

$$\tau = f(\gamma)$$

the energy per unit volume absorbed locally is

$$u = \frac{3}{2}\int_0^\gamma \tau\, d\gamma = u(\tau) = u\left(\frac{3}{2}\pi\sigma_1\right)$$

Local energy is thus expressed as a function of triaxiality and of stress intensity in which the measures of these two quantities appear in a simple product. The two cofactors are equal in importance, and an increase in one can be offset by a proportionate reduction in the other.

Palm describes an ingenious geometrical construction which well exhibits the relation between n_2, n_3, and π, shown herewith in Fig. 1. The point of full triaxiality is at $n_2 = n_3 = 1$, and π at this point is zero. The full range of possibilities when none of the principal stresses is negative is included in the triangle bounded by $n_3 = 0$, $n_2 = 1$, $n_2 = n_3$. Within this region the various straight lines through the point $n_2 = n_3 = 1$ correspond to the various choices as to the value of n_2, ranging from $n_2 = n_3$ to $n_2 = 1$. Thus if a is the fraction

$a = (1 - n_2)/(1 - n_3)$, then $n_2 = 1 - a(1 - n_3)$

and

$$\pi = \sqrt{(1 - a + a^2)\,(1 - 2n_3 + n_3^2)}$$

The straight lines correspond to constant values of a, which measure their slopes.

Contours of equal π are ellipses centered on the zero point with major axes along the line $n_2 = n_3$ of half-lengths $\sqrt{2}\pi$ minor axes $\sqrt{\frac{2}{3}}\pi$.

Although this definition of π is somewhat arbitrary, it is consistent with other considerations and, so far as they are precisely known, with the material facts. We should not be misled, however, by assertions (2) referring to "brittleness due to shape" or "dimensional fragility," said to be easily explained in the light of these definitions and found in all steels "except those that possess a good coheracy and those that have no dynacity." It will now be our object to translate such a statement into language current in the U. S.

Let us speak first of the criterion of the lower limit of plastic action as affected by triaxiality. This is a limit of stress-value and it depends on the material; thus, "yield strength" as reported in the familiar tension test. But the yield strength in other tests (for example, notched tension specimens) may be quite different from that in the simple tension test applied to the identical material. It is agreed, as an observed fact, however, that when this limit is expressed in terms of effective stress the same value will be found in all states of stress. The only condition is that the test must be such as will permit evaluation of the effective stress. This is true for the notched tension specimen and for hollow cylinders under axial and hoop tension. It is said also to be true (at least approximately) for the special test of Schnadt's invention.

The experimental evidence for this property of the effective stress comes mainly from tests under variable biaxial loading (7). In a plot on axes of σ_1 and σ_2 various ratios $n_2 = \sigma_2/\sigma_1$ are represented by radial lines through the origin. When the yield point is marked on each of a series of such radial lines, the points fall, at least roughly, on the ellipse of constant effective stress value.

Schnadt proposes a plot of more comprehensive nature in which the variables are the two controlling quantities, intensity and triaxiality. To measure the latter he uses π and for intensity the greatest principal stress σ_1. In this diagram the contour of constant effective stress is a hyperbola, as in Fig. 2. One such curve marks the boundary between the elastic and plastic regions in the diagram. Schnadt's diagram is wholly schematic, however, since no observed data are offered. Nevertheless it represents conditions generally accepted as factual. In particular it shows very clearly the fact that under high triaxiality (low π) high intensity is needed to cause yield.

Beyond the point of yielding things are more difficult, especially in approaching the upper limit of plastic flow at fracture. This is shown by Palm as another hyperbolic contour denoting fracture at another constant but higher value of effective stress. This is partly conjectural, however, and another type of fracture curve is also suggested, though with no supporting evidence.

These two curves, for yield and fracture, are boundaries between three regions on the diagram and these are labeled by Palm in terms relating to types of fracture. Below the point of

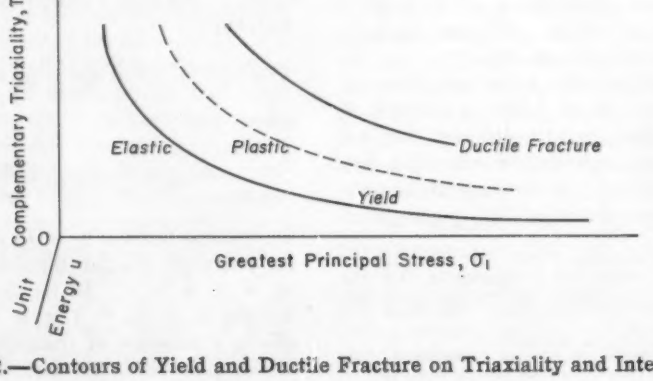


Fig. 2.—Contours of Yield and Ductile Fracture on Triaxiality and Intensity.

yielding, fracture is said to be by "brittle cleavage" (decohesion direct); between the two curves by "ductile cleavage" (decohesion indirect); and beyond the upper curve by "shear." Now these three different types of fracture are well recognized, but how do regions in this diagram come to be associated with fracture at all? The upper curve defines the conditions of fracture after fully ductile action, completely plastic behavior. The diagram suggests that when the metal falls short of such behavior, for whatever reason (low temperature, for example) it may fracture in an intermediate mode subject to control of other circumstances not explicit in this diagram. It may be supposed that under these circumstances fracture may follow an intermediate curve as dotted in Fig. 2.

If the metal is brittle enough (as medium steel at very low temperature) fracture may occur before yield. It is stated that at values of π below a limit φ completely brittle fracture will occur at a limiting value of σ_1, regardless of further reductions in π. But the circumstances under which the intermediate case of ductile cleavage may occur are not stated.

The matter of energy absorption may now have further comment in the light of the quantities plotted in Fig. 2. Since, as was noted earlier, the energy per unit volume absorbed locally, u, is a function of both π and σ_1, triaxiality and intensity of stress, then it may be plotted on a third axis, normal to those of π and σ_1. The contours on the surface thus defined are the hyperbolas of equal effective stress, of which three are shown in Fig. 2. Whatever phenomena, such as yield or fracture, are said to be determined by the value of effective stress may equally well be said to be determined by the local intensity of energy absorption.

In discussing the π, σ_1 diagram, Palm alludes to a quantity analogous to π, but referring to strain instead of stress. It is denoted by ψ and it equals (except for a numerical factor) the ratio of effective strain to the greatest principal strain. Accepting the constancy of the ratios

$$\frac{\sigma_1 - \sigma_2}{\epsilon_1 - \epsilon_2} = \frac{\sigma_2 - \sigma_3}{\epsilon_2 - \epsilon_3} = \frac{\sigma_3 - \sigma_1}{\epsilon_3 - \epsilon_1} = \frac{3}{2}D$$

the lines of constant a in the n_2, n_3 diagram are also lines of constant ψ, such that

$$\psi = (2\sqrt{3}\sqrt{1 - a + a^2})/(1 + a)$$

Note especially that the analogy between π and ψ does not extend to their graphical interpretations.

Although the effective stress and the effective strain stand in a relation to each other expressed by the stress-strain curve, π and ψ do not have a single-valued functional relationship. A point in the n_2, n_3 diagram may be fixed by assigning values to any two of the four quantities n_2, n_3, π, and ψ. The stress-strain curve gives assurance, however, that to each value of effective stress and unit energy absorption a value of effective strain also corresponds. For a simplified engineering theory of fracture we may suppose that it will occur at a critical value of any one of these three quantities.

This theory is subject to one restriction, however, namely, that at very high triaxialities, at which π is less, say, than $\sqrt{3}/4$, fracture is conditioned by intensity alone and triaxiality is no longer of influence. It is possible that such high values do not actually occur in service in conjunction with high intensity, but such conditions might be produced by special loading in the laboratory, associated with the rather elusive term "cohesive strength." Schnadt designates as "co-polar" the point in the π, σ_1 diagram where the yield curve is cut by the value of σ_1 beyond which fracture can occur without shear. This point is designated φ.

At any given point in the plastic region, the excess $\pi - \varphi$ is called the "paratential" and is designated Ω. This is the quantity said to be significant for service performance. "The raising of the paratential is a very important constructional principle. There are two ways of doing this: first, by plastifying the stresses by raising their plastifying power π; second, by plastifying the metals by decreasing their endobrittleness φ." We will try to translate this claim into terms current in the U. S. and to evaluate it.

Note first that the paratential is dimensionally the same as π, the complementary triaxiality. This is a novelty, and Schnadt's thought departs here in a radical way from usual practice, according to which most features of performance of a test specimen, model, or service structure are evaluated in terms of intensity of stress, σ_1. The process of design for strength is one of matching nominal working values with permissible values; traditionally these are values of stress. This need not imply that in conventional practice the intensity of stress is the only consideration, though that is a widespread and rather naive conception. But it does imply that all values of serviceability can be determined in terms of strength, just as in traditional economics all human values are stated in dollars.

As an example, note that standard practice estimates safety as a factor (8), applied to a quantity of the dimensions of stress. Schnadt, on the other hand, estimates safety as a margin of difference Ω between a value of triaxiality π applying to the service structure and the critical value of the same, φ, at which the ductility of the metal becomes, for practical purposes, zero. Paraphrasing the passage quoted above, the margin of safety may be increased either (*a*) by reducing triaxiality (increasing π); the resource lies in control of the geometry of the loaded structure; or (*b*) by reducing the inherent brittleness of the metal as measured by the value φ of triaxiality at which fracture occurs with unacceptably small prior deformation.

The main lines of the further development of Schnadt's procedure are as follows. A scale of test specimens is set up in which a series of degrees of triaxiality are established. The material proposed for use is placed on this scale according to its capacity for ductile behavior. This capacity on the part of the metal is matched against a requirement on the part of the service structure. The condition to be satisfied is that the characteristic value of triaxiality associated with the structure shall be lower (π higher) than the critical value φ associated with the metal. $\Omega = \pi - \varphi$ must exceed zero.

Now these quantities are still not expressible as numbers in a continuous series. The scale consists of discontinuous increments, and it is to these steps on his scale that Schnadt has given the bizarre names that have seemed the most prominent feature of his method. It is better to refer to them in terms of notch diameter, for this is the parameter chosen for basic variation. The scale is as follows:

Notch diameter d, mm. . . .	Inf.	10	8	4	3	2	1	½	0
Complementary triaxiality, π	0.866			0.7 to 0.6					0.433
$100d/(d + 2)$, π in "venants"	100	83.3	80	66.6	60	50	33.3	20	0

Comment is offered as follows. When these ideas are thus clarified they seem sound in principle. The principle is this: to establish a scale of severity of notching in test bars on which to place a material with respect to its suitability in notch toughness for use in a given structure. This same principle has been advanced elsewhere, for example, by MacGregor and Grossman (9). Nevertheless some reservations with respect to Schnadt's method are necessary.

1. As pointed out by Palm it ignores size effect; or, at least, it tacitly lumps size effect with other items of uncertainty in estimating working values for a service structure.

2. More generally, it provides no methodical procedure for estimating these working values. In this, however, it follows traditional methods also used in arriving at stress-dimensional safety factors.

3. The consideration given to effects of temperature is not adequate, and this is even more true of strain rate, which is that of the Charpy test, regardless of service conditions. The method ignores the kind of data taken by MacGregor and Fisher (10) on equivalence between strain rate and temperature.

4. The method oversimplifies the facts in ignoring various aspects of brittleness in its relation to fracture. No consideration is given to the circumstances under which ductile cleavage occurs or to the question how the brittleness of the fracture can be significant when stress intensity is not high enough to cause fracture of any kind.

5. What prevents fracture in the numerous cases in service where cold brittleness does not appear though all known circumstances are identical with those in known cases of cold brittle fracture?

6. Finally, in evaluating his material term, Schnadt places it, not at the point of complete absence of plastic deformation, but at a "deformation of 10 per cent." Since such a figure can only be completely nominal, this amounts to making all choices purely on a basis of judgment.

The residue of benefit in the method consists in accepting triaxiality or, more generally, capacity for plastic deformation, as the guide in judgment. This residue, however, has great value, enough to justify all the interest which Schnadt's ideas have attracted.

NOTE (May 5, 1951).—After completion of the above comment, my attention was brought to the paper of R. Weck in the *Transactions*, Inst. Welding, April, 1950, and also to a letter of Hans Schwarz of March 21, 1951, in which Schnadt's ideas are further explained. The basic procedure which I have described has now also been used for plotting effects of temperature on brittleness, with introduction, however, of new coined words which interfere with application of these ideas in America. Further comment extending to these new developments will later also be offered.

REFERENCES

(1) E. P. Klier, F. C. Wagner, and M. Gensamer, "The Correlation of Laboratory Tests with Full-Scale Ship Plate Fracture Tests," *Welding Journal*, Vol. 27, Feb., 1948, pp. 71–96-s.

(2) J. H. Palm, "The Theoretical Background and Interpretation of the Schnadt-Impact-Test," *Metalen*, Vol. 4, Nos. 9, 10, and 11, May, June, and July (1950).

(3) H. M. Schnadt's discussion of paper by Klier, *et al.*, (1) *Welding Journal* Vol. 27, Dec., 1948, pp. 614–616-s.

(4) C. J. Osborn, A. F. Scotchbrook, R. D. Stout, and B. G. Johnston, "Comparison of Notch Tests and Brittleness Criteria," *Welding Journal* Vol. 28, Jan., 1949, pp. 24–33-s.

(5) G. Sachs and J. Lubahn, "The Effect of Triaxiality on the Technical Cohesive Strength of Steels," *Journal of Applied Mechanics*, Vol. 12, Dec., 1945, pp. 241–252.

(6) W. P. Roop, "Stress and Strain in Plastic Flow," *Welding Journal*, Vol. 25, Sept., 1946, pp. 799–823.

(7) A. Nadai, "Plasticity," McGraw-Hill Book Company, Inc., New York, N. Y., p. 185 (1931); see also paper by E. A. Davis, "Yielding and Fracture of Medium Carbon Steel under Combined Stress," *Journal of Applied Mechanics*, Vol. 12, March, 1945, pp. 13–24.

(8) W. P. Roop, "Features of Practice Affecting Design," *The Log*, Vol. 28, Dec., 1936–Jan., 1937, pp. 10–14, 21–22.

(9) C. W. MacGregor and N. Grossman, "The Effect of Combined Stresses on the Transition Temperature for Brittle Fracture," *Welding Journal*, Vol. 27, Jan., 1948, pp. 7–16-s.

(10) C. W. MacGregor and J. Fisher, "Tension Tests at Constant True Strain Rates," *Journal of Applied Mechanics*, Vol. 12, pp. 217–227 (1945).

Laboratory Measurement of Iron Losses at Audio Frequencies

By C. C. Horstman[1] and A. Lucic[1]

SYNOPSIS

This paper describes an instrument for laboratory testing of core material for iron core inductor components at frequencies higher than 60 cycles. It was developed primarily for use in the research work connected with the development of thin-gage cores for aircraft components used in the military miniaturization program. The paper includes a description of the equipment and lists the operational details of the instrument and the special requirements for obtaining accuracy and reliability in these higher frequency measurements. An over-all accuracy of 2 per cent is maintained at frequencies below 5000 cycles, and this equipment has been checked with various other laboratory equipments and found to be within 0.55 to 4 per cent in comparative results at frequencies ranging up to 10,000 cps. While tests have been made at frequencies ranging from 20 to 15,000 cycles, the most useful range is from 350 to 1200 cycles, at which range core material samples up to 5 lb (Figs. 1 and 2) can be readily tested with excellent wave form up to inductions of 15 kilogausses. Tests up to 18 kilogausses can be performed with reasonably good wave form.

With an ever-increasing interest in thin-gage core material development for use at frequencies higher than 60 cycles, it becomes necessary to have a laboratory instrument capable of making measurements accurately. Over the past few years, such an instrument has been developed at Westinghouse Sharon Works Laboratory. The most recent application of this instrument was to assist in the development of 4-mil thick Type C wound cores for aircraft components to be used in the military miniaturization program. As in any development program, it is essential to have a reliable yardstick to measure progress, and, in this case, it was necessary to measure core loss and excitation volt-amperes at 350 to 1200 cycles with accuracy on both Epstein samples and built-up cores as actually used in transformers and reactors.

It was necessary that this equipment be flexible, practical, and relatively trouble-free because of the large amount and variety of test work to be done. The equipment is essentially electronic and follows the basic method outlined in ASTM Method A 343[2] for standard power frequencies. Fundamentally, the apparatus is the same, varying only in power source and frequency response.

EQUIPMENT

The equipment (diagrammed in Fig. 3) used has seven major components:

1. An oscillator source capable of

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Consulting Engineer and Laboratory Engineer, respectively, Westinghouse Electric Corp., Sharon, Pa.

[2] Standard Methods of Test for Alternating Current Core Loss and Permeability of Magnetic Materials (A 343 – 49), 1949 Book of ASTM Standards, Part 1, p. 1188.

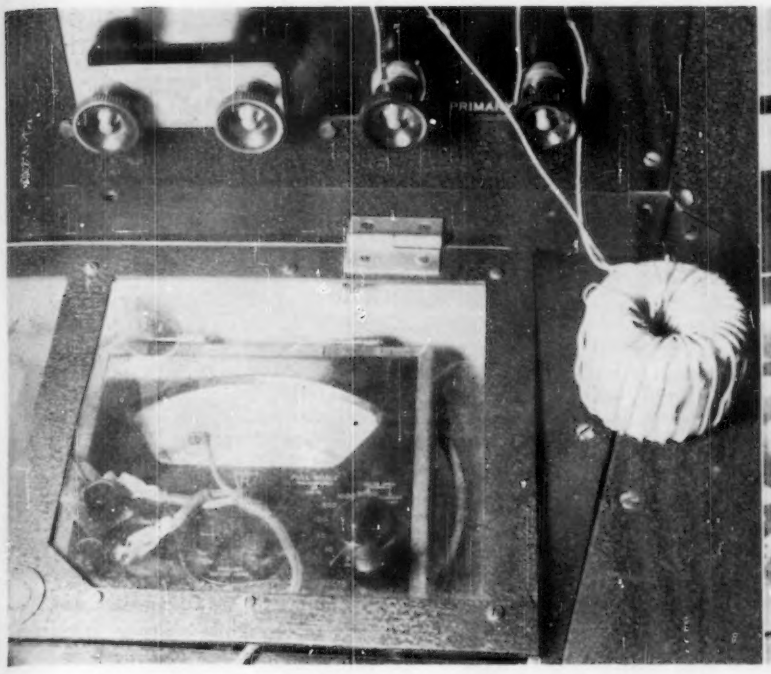


Fig. 1.—Ring Sample of Core Material Under Test.

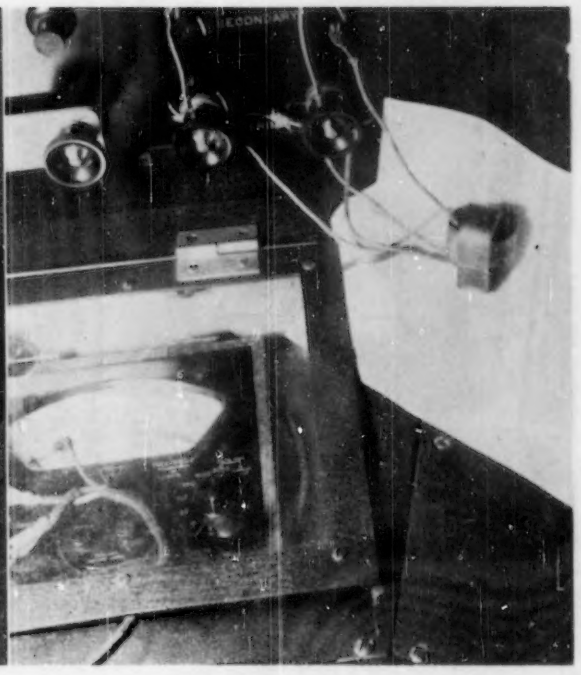


Fig. 2.—Hipersil Type C Transformer Core Under Test.

producing a very stable sine wave voltage was secured through the use of an oscillator which covered a frequency range of 0 to 40,000 cycles with a maximum variation of 2 per cent ± 1 cycle.

2. A specially designed amplifier capable of delivering 500 w on any impedance tap with a frequency response of 30 to 15,000 cps served as power source for the audio frequency tests previously mentioned. The output stage consists of class B 810 tubes operating at approximately 50 per cent efficiency. The output transformer of this amplifier is tapped to give impedance values of 1, 2, 3, 4, 6, 8, 16, 24, 50, 125, 150, and 500 ohms.

3. A high-sensitivity, high-frequency, low-power factor, dynamometer type wattmeter (Fig. 4) was built having four two-turn coils wound of Leitz wire of large current capacity. The potential coils are of the suspended type having high sensitivity, due in part to the integrally mounted mirror which permits long light paths. With a light path of 2 m and with 15,000 ohms in series with the potential coil, 500 w will give a deflection of 50 cm on the scale.

4. A Baby Epstein frame (Fig. 5), designed for testing 3 by 28-cm samples and described in ASTM Method A 34,[3] is used in conjunction with our audio frequency test equipment. As constructed, an electrostatic shield was included between the primary and secondary windings. The primary and secondary each have 352 turns divided equally between four coils arranged in a square configuration.

5. The high-frequency voltmeter used was of the thermal type for frequencies up to 5000 cycles. A Rawson multimeter, type 502, or a Weston thermo-voltmeter, type 622, gives good accuracy in this frequency range. Above 5000 cycles, electronic voltmeters such as the Ballantine Md-300A voltmeters are suitable.

6. A high-frequency ammeter suitable for measurements in audio frequency range is the Weston Model 622 thermocouple ammeter with external heating elements. This meter has an accuracy of 0.5 per cent at 25,000 cycles.

7. An oscilloscope for checking wave form (Fig. 6). This was especially useful for selecting the amplifier impedance tap that would give the best wave form.

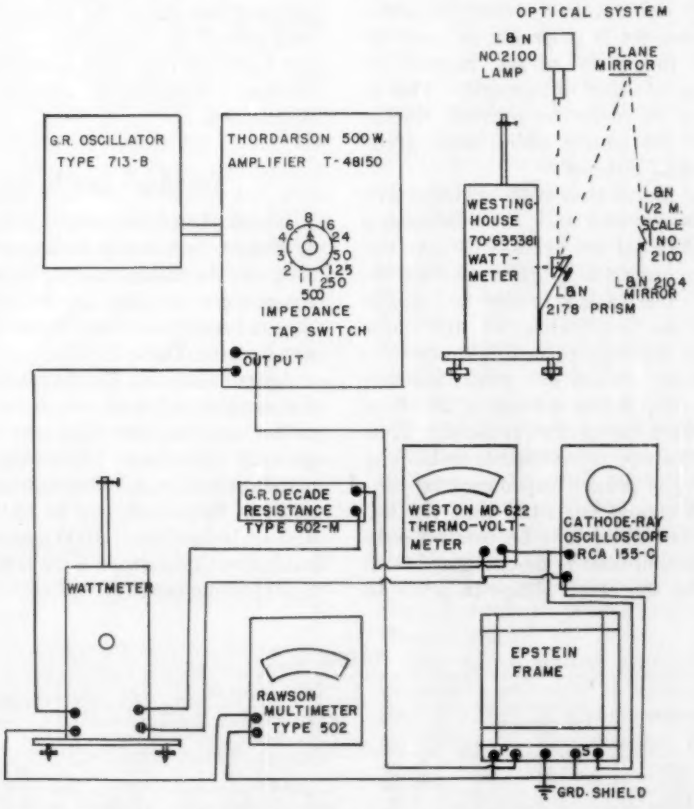


Fig. 3.—Block Diagram of Complete Instrument. 20–15,000 Cycle Test Equipment.

[3] Standard Methods of Testing Magnetic Materials (A 34 – 49), 1949 Book of ASTM Standards, Part 1, p. 1145.

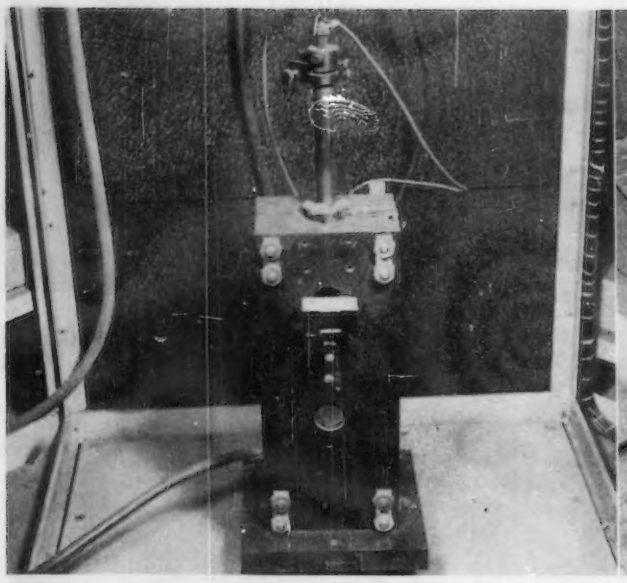


Fig. 4.—High-Frequency, High-Sensitivity, Low-Power Factor Wattmeter—Light Beam Type.

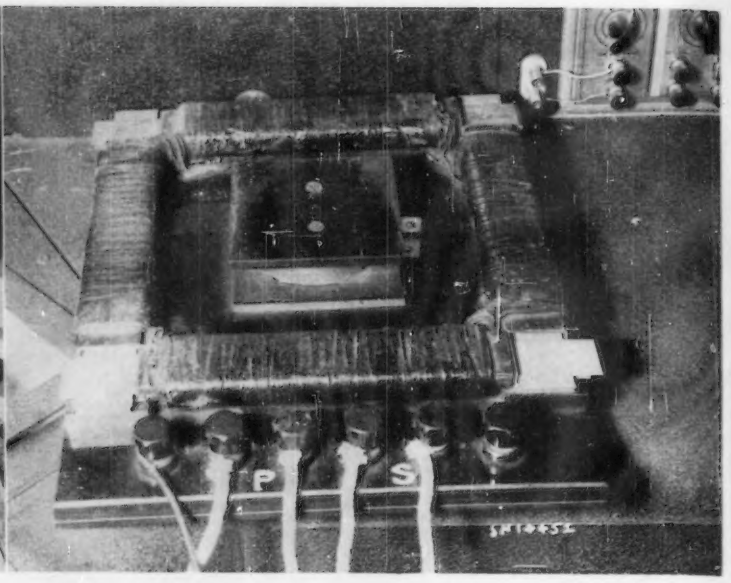


Fig. 5.—Baby Epstein Frame for Standard 3 by 28 cm Samples.

Operation and Special Requirements

The biggest problem that one is faced with in higher than power frequency testing is the problem of metering. Accurate tests require first of all a wattmeter having very low reactance. The current coils should be wound of Leitz wire of large current-carrying capacity, and should have as few turns as will give the desired sensitivity. There should also be sufficient resistance in the multiplying resistor to minimize the effect of the reactance of the potential coils. The multiplying resistance should, of course, be wound noninductively to minimize its reactance.

The rms voltmeter should be accurate. A good thermocouple or electronic type can be used over a wide range of frequencies, providing the wave form is good. However, it is possible to make measurements with relatively poor wave form if corrections are made.

An oscilloscope is valuable not only for observing wave form, but also as a means of checking frequency. By using an electrically driven tuning fork to produce a 1000-cycle voltage which is applied to the horizontal plates of the oscilloscope and with the secondary test voltage applied to the vertical plates of the oscilloscope, Lissajous figures are obtained which can be interpreted for frequency checks.

A very stable source of 60-cycle power to the test set is desirable in order to prevent inductive surges caused by switching of other equipment. This is necessary in order to prevent fluctuations in the meters which make accurate reading difficult.

It was found that with an inductive sample of core and coils, the relationship of $Z = E/I$ did not necessarily give the amplifier output impedance setting required. The sample under test might indicate an impedance of 400 ohms based on the ratio of E/I, yet observations of the oscilloscope would indicate that an output tap setting of 24 ohms will produce the best wave form. Thus the oscilloscope is invaluable in helping to select the proper impedance tap setting. It should be noted that the tap selector switch should be rotated only when the amplifier is de-energized with respect to the test voltage in order to prevent inductive surges which would puncture the output transformer windings of the amplifier.

In general, multiple grounds should be avoided to minimize electrostatic potential differences. All the grounds should be carried to the same point in the testing circuit. One side of the primary and secondary of the test frame or coils should be connected together and grounded. The current coils of the wattmeter and ammeter should be grounded and the multiplier decade resistance box should be connected in the high side of the secondary. By keeping the wattmeter leads as short as possible, leakage capacitance effects can be minimized.

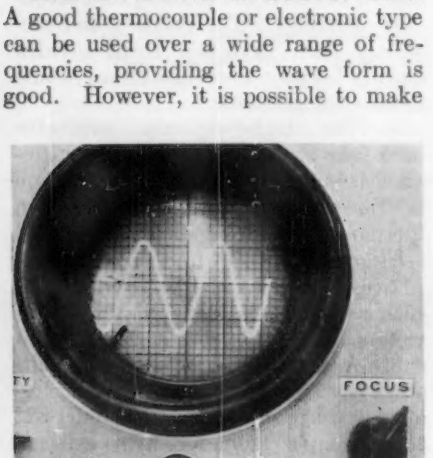


Fig. 6.—Typical Wave Form Shown on Oscilloscope Built into Instrument.

Accuracy and Range

Check tests on similar equipment (different operators) indicate comparative results within 0.55 to 4 per cent at frequencies ranging up to 10,000 cps. Typical results on 3-mil Epstein samples are given in Table I.

Larger cores can also be readily tested, due consideration of course being given to keeping the induction low enough to prevent distortion. Recently, we had occasion to test a 300-lb modulation reactor at frequencies up to 15,000 cycles and an induction of 1000 gausses. The equipment performed very creditably in this extreme range of size and frequency.

TABLE I.

Frequency	Induction, kilogausses	Loss, w per lb			Difference, per cent
			First Check Test	Second Check Test	
840.....	10	11.72	11.7	11.3	1.76–3.58
1 000.....	10	14.52	14.6	14.0	0.55–3.57
5 000.....	2	7.2	7.15	7.52	0.70–4.44
10 000.....	2	16.87	16.5	16.92	2.2–2.96

Fatigue Tests Under Axial Loads of Aluminum Joints Bonded with a Resinous Adhesive

By W. N. Findley,[1] B. A. Century,[2] and C. P. Hendrickson[3]

SYNOPSIS

Results of fatigue tests of aluminum alloy joints bonded with a resinous adhesive are presented. Single-lap, double-lap, and butt joints were tested in an axial-load fatigue machine. The methods of testing, the merits of the three procedures employed, and the test results obtained are discussed. The fatigue strength at 10^7 cycles was found to be about three times as large for the butt joints as for the lap joints. It is indicated that differences in state of combined stress may account for some of the observed differences in test results.

IN THE aircraft and automotive industries the use of adhesives for bonding metal parts has been studied with considerable interest. For such applications the ability of the adhesive to withstand repeated loads and vibration is of great importance. The present paper reports studies of some methods of testing adhesive joints for resisting repeated loading (fatigue) and presents data on the fatigue strength of one type of adhesive when it is used to bond aluminum parts.

Methods of loading which have been considered for fatigue tests of adhesives are:

1. Cantilever bending of specimens made as lap joints;
2. Simple-beam bending of specimens made as lap joints; and
3. Axial loading of lap-joint and butt-joint specimens.

Fatigue tests of adhesives using the second method have been reported in the literature.[4] Such tests are suitable as simulated service tests for evaluating the relative merits of different joints which are to be subjected to this type of loading. However, as fatigue tests of the adhesive they have the disadvantage that the stress in the adhesive is very difficult to calculate with precision since the applied bending moment produces an unknown variation in stress across the area of the bond. This distribution of stress is probably affected by the relative stiffness of the adhesive and adherend.

The present tests are concerned with the third method—axial loading of single-lap, double-lap, and butt-joined specimens.

MATERIALS AND TEST SPECIMENS

The plates from which the shear specimens were fashioned and the machined parts from which the butt-jointed specimens were made were bonded together with Cycleweld adhesive C-3-S-50, by the Cycleweld Division of the Chrysler Corp.[5] The shear and butt-joined parts were made of 24S-T and 75S-T aluminum alloy, respectively.

The C-3-S-50 cement is a chloroprene polymer in combination with a cresylic resin. It requires an acid catalyst. During the cure, three basic reactions take place: vulcanization of the elastomer, condensation of the cresylic resin, and crosslinkage (in a minor degree) of the two reactants. The as-received cement has a pH of 5 to 6.

Adhesive from the same batch was used for all specimens, although the specimens were prepared at different times. The bonding procedure was as follows. The aluminum parts were cleaned either by immersion in two consecutive cleaning baths, the first consisting of sodium metasilicate, nacconol NR, and tap water, and the second consisting of chromic acid and water; or by rubbing lightly with steel wool and a quick drying solvent. The latter method abraded the surface slightly and might have produced a more effective bond. Test results reported by Chrysler Corp. indicate this effect to be negligible if existing at all.

The adhesive was sprayed on appropriate sections to a thickness (when dry) of 0.0015 in. and allowed to air dry for 30 min. The samples were then baked in an oven so as to produce a temperature in the film of 180 F for 20 min. The parts were then assembled and the bonded areas subjected to a pressure of 200 psi by means of a special spring and clamp. Curing of the adhesive was accomplished by heating the entire assembly in an oven. The temperature of the cemented area was held at 325 F for 20 min.

The single-lap specimens (Fig. 1(*a*) and 1(*b*)) and the double-lap specimens (Fig. 1(*a*) and 1(*c*)) were machined from rectangular plates after the joints had been bonded. The specimens were cut to approximate shape on a band saw, then finished on a milling machine. To prevent damage to the adhesive joint, a special clamp was used during machining. Static lap-joined specimens were machined from scrap portions of the single- and the double-lap fatigue specimens, as shown in Fig. 1(*a*).

The butt joints for both fatigue and static tests consisted of two identical halves whose circular ends were bonded with the adhesive (see Fig. 1(*d*)). Each of the butt-joint halves had reduced sections for the sake of flexibility, a property necessary for subsequent manipulation in the distortion-detecting operation. The butt-joint halves were machined prior to bonding except for the reduced sections which were machined last since the need for them was not anticipated.

APPARATUS AND TEST PROCEDURE

All tests were carried out in a room maintained at a constant temperature of 77 ± 1 F and a constant relative humidity of 50 ± 2 per cent.

Fatigue Tests:

The fatigue tests were performed on two similar axial load fatigue machines such as shown in Fig. 2. The load was applied by means of an adjustable throw crank *A* and a lever *B*. The magnitude of the alternating load was measured by a dial *C* mounted on a ring-shaped dynamometer. All tests were conducted at a mean stress of zero and at a speed of 1750 cycles per minute.

Butt Joints.—The axial-load fatigue machine, as used for the tests of the butt joints, was described in a previous paper.[6] It was equipped with a means

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Research Associate Professor, Department of Theoretical and Applied Mechanics, College of Engineering, University of Illinois, Urbana, Ill.

[2] General Electric Co., Pittsfield, Mass., formerly Instructor, University of Illinois, Urbana, Ill.

[3] Public Service Co. of Northern Illinois, Midlothian, Ill., formerly Assistant, University of Illinois, Urbana, Ill.

[4] A. G. H. Dietz and H. Grinsfelder, "Fatigue Studies of Urea Assembly Adhesives," *Transactions*, Am. Soc. Mechanical Engrs., July, 1944, pp. 442–446.

[5] Cycleweld Chemical Laboratory, *Minor Report MRC47-81*, Chrysler Corp., Detroit, Mich.

[6] W. N. Findley, "New Apparatus for Axial-Load Fatigue Testing," ASTM BULLETIN, No. 147, August, 1947, p. 54.

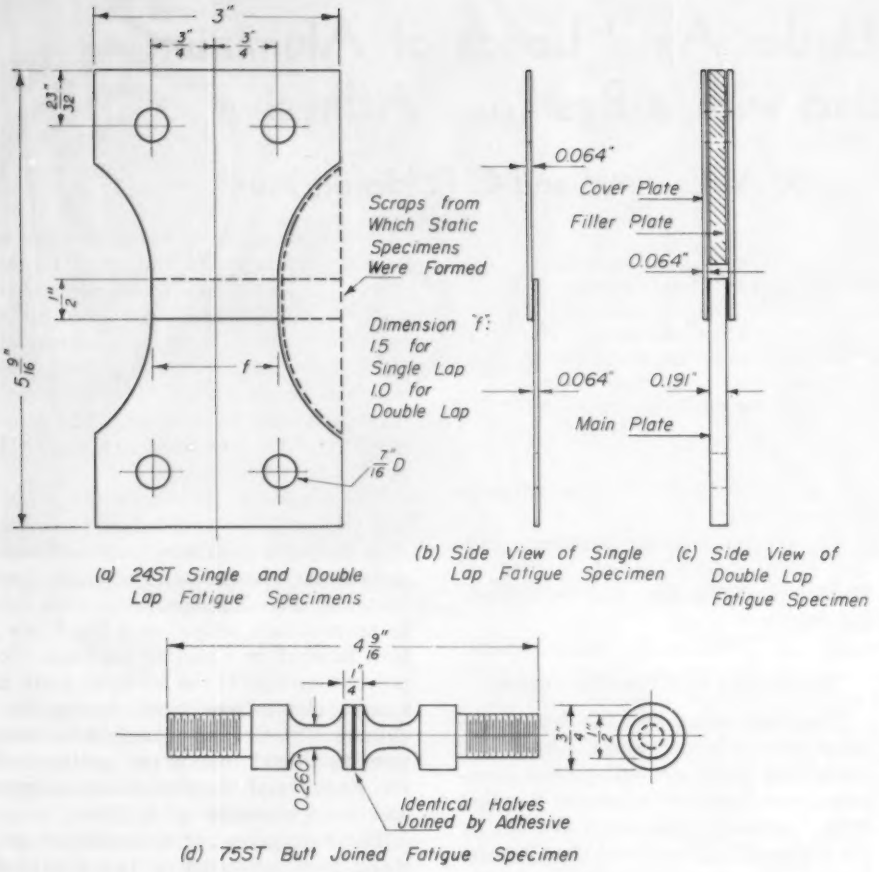


Fig. 1.—Specimens for Fatigue Tests of Cycleweld Adhesive.

for detecting and correcting strains introduced in the butt-joined specimen when it was placed in the grips. The distortion detector *D* (Fig. 2) was used to indicate the initial strains in the specimen. After correction of initial strains, the distortion detector was removed before the test was started.

Single-Lap Joints.—The fatigue machine used for the lap joint tests was the same as that used for the butt-joint tests, but a different method of gripping was employed. Channel-shaped blocks in which the specimen was clamped between the two flanges of the channel were used. The clamping was accomplished by means of filler plates and bolts.

With the specimen rigidly fastened in the lower grip, the grip on the upper head, which was adjustable laterally, longitudinally, and rotationally was made fast to the specimen and adjusted so as to distort the specimen as little as possible. Alignment of the upper grip (as determined by eye) and fit of the upper bolts (as determined by the ease of insertion) were used as measures of proper adjustment.

Double-Lap Joints.—The test procedure for the double-lap joints was similar to that for the single-lap joints except for the following. Bending in a plane normal to the face of the specimen, which occurred during gripping the specimen, was measured and corrected by means of the adjustments described above. The bending was indicated by a dial attached to one of two rods in such a way as to indicate relative movement between their ends. The rods were fastened to the specimen above and below the lap joint at points about 2 in. apart so that bending of the joint would cause a relative movement between the ends of the rods. By use of this indicator, bending in the plane normal to the face of the specimen was limited to 0.7 min of angle or less.

Static Tests:

The static tests were performed on an Olsen 10,000-lb beam type testing machine. The single-lap test strips were held in self-aligning wedge grips. The loads applied to the double-lap specimens were transmitted by means of pins which were inserted through accurately located holes on either end of the specimen. The pins were mounted in clevises which were fastened to self-aligning threaded grips. All specimens were loaded at a rate of crosshead motion of 0.04 in. per min, and only the maximum load was recorded.

The number of butt-joined specimens available was insufficient for both fatigue and static tests. Consequently the fatigue tests were run first. Static tests were then performed on three specimens previously tested in fatigue. One of the specimens had not failed at all in the fatigue test and the other two had fractured in the aluminum alloy parts, but not in the adhesive.

Results and Observations

The results of the fatigue tests are shown in the form of *S-N* diagrams in Fig. 3, and the static ultimate strengths are given in Table I. Considerable variation was found in both the static and fatigue results. Variations in fatigue results produced rather wide scatter bands (especially for the butt joints) as shown in Fig. 3. The fatigue strengths at 10^7 cycles and zero mean stress were 520 ± 20 psi and 640 ± 40 psi shearing stress for the double-lap and single-lap specimens, respectively; and 1640 ± 200 psi normal stress for the butt-joined specimens. Average values of static ultimate strength were 1850 and 2710 psi shearing stress for the single- and double-lap specimens, respectively, and 4980 psi tensile stress for the butt joints.

These data show that the average static strength of the double-lap specimens was about 50 per cent greater than the single-lap specimens; whereas the fatigue strength of the double-lap specimens was about 19 per cent less than that for the single-lap specimens.

It was observed that the surfaces of failure, especially of the lap joints, consisted of both cohesion and adhesion failure. Following this observation, the portions of the areas of the double-lap specimens which showed a cohesive

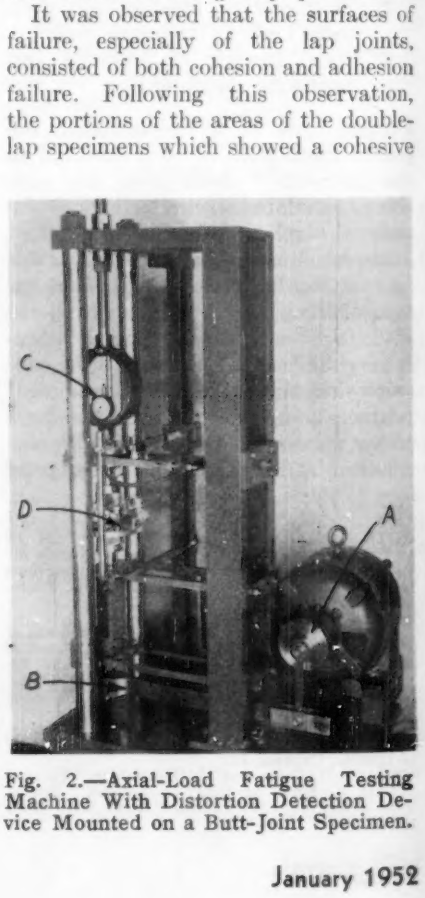


Fig. 2.—Axial-Load Fatigue Testing Machine With Distortion Detection Device Mounted on a Butt-Joint Specimen.

TABLE I.—STATIC TESTS OF CYCLEWELD BONDED ALUMINUM JOINTS.

Single-Lap Specimens		Double-Lap Specimens		Butt-Joined Specimens	
Panel from Which Specimens Were Cut	Average Shearing Strength of Panel, psi[a]	Panel from Which Specimens Were Cut	Shearing Strength of Specimens,[b] psi	Fatigue Strength,[c] psi	Tensile Strength, psi
A.....	2140	3	3020 2800	2400	4750
B.....	1930	4	3610 3390	1400	4480
C.....	1050	6	3850 1950	2600	5720
D.....	2130	7	1285 2200	...	...
E.....	1990	10	1475 3560	...	...
Average...	1850	..	2710	...	4980

[a] The number of single-lap specimens per panel varied from four to seven.
[b] Two double-lap specimens were cut from each panel.
[c] The butt-joined specimens had been subjected to a fatigue test prior to the static test.

failure were measured by a planimeter and the ultimate strengths of the static specimens were recomputed using these areas. The values obtained were no more consistent than the original values.

The wedge grips used in the static tests of the single-lap specimens may have contributed to the lower strength of these specimens.

The quality of the butt-joined specimens used for static tests was open to some question because of the fact that all three specimens tested had been subjected to fatigue testing previous to static testing. In view of the negligible effect of repeated stresses on the static strength of other materials it seems unlikely, however, that the static strength was greatly affected unless actual fatigue cracks had developed in the adhesive. Also, the variation in static strength of the three specimens did not follow a pattern that might be ascribed to the prior cycles of stress or the differences in diameter. For example: the higher the fatigue stress previously maintained the higher the static strength; the specimen having the largest diameter had the lowest static strength; and the specimen with the highest static strength had been subjected to a number of stress cycles intermediate between that of the other specimens.

It was of interest to find that three fatigue specimens fractured in the aluminum parts. One single-lap specimen developed a large crack in the plate adjacent to the joint but finally fractured in the adhesive. One butt-joined specimen fractured at the edge of the fillet in one of the reduced sections where the nominal tensile stress was 18,900 psi and the stress concentration factor was 1.25. The fatigue strength at 10^5 cycles for this aluminum alloy was 36,000 psi under tension-compression fatigue tests at zero mean stress. A second butt-joined specimen fractured in the threaded portion of the grip and under a nominal stress of 3850 psi. The stress concentration factor was probably about 3 and the fatigue strength of the alloy at this number of cycles (4×10^6) was 25,000 psi. No satisfactory explanation has been found for failures in the aluminum alloy at these low stresses.

After the first metal failure in the butt-joined specimens, the test sections of the remaining specimens were machined to a much smaller diameter (0.61 in.). In spite of this precaution, one of these specimens fractured in the aluminum and both of them withstood a much greater number of cycles than consistent with the other data. This suggests either that the scatter was greater than shown by the scatter band in Fig. 3 or that the central portion of the adhesive joint was stronger than the outer ring of adhesive removed by the machining.

It was found that the width of the scatter band for fatigue tests of single-lap joints would be reduced slightly by dividing the alternating stress for each test by the static ultimate strength of the sample from which the fatigue specimen was taken and plotting these ratios instead of the stress values. This procedure was not extended to the double-lap joints because static specimens corresponding to each fatigue specimen were not available and because of the inconsistencies in those static strengths obtained (see Table I).

The observation that the adhesive was much more readily loosened[7] from the broken halves of the double-lap and butt specimens than the halves of the single-lap specimens may indicate a difference in the adhesive or its adhesion.

Effect of State-of-Stress

The state of combined stress in the adhesive of a joint is probably an important factor in determining the strength of the joint. Hence, it is also an important consideration in selecting the type of specimen to be used in tests to determine the strength of an adhesive.

In the following paragraphs a quali-

[7] The adhesive was removed from these halves in preparation for rejoining them. A solvent consisting of 70 per cent methyl ethyl ketone and 30 per cent monochloro benzine was used to loosen the adhesive film.

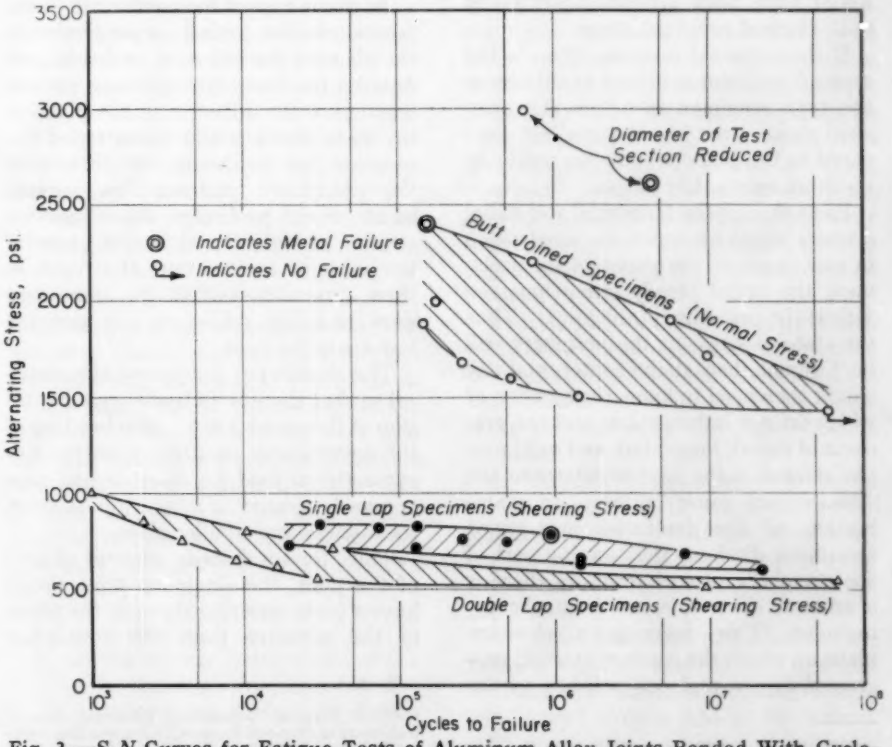


Fig. 3.—*S-N* Curves for Fatigue Tests of Aluminum Alloy Joints Bonded With Cycleweld Adhesive. All Tests Were Conducted at a Mean Stress of Zero, Temperature of 77 F and a Relative Humidity of 50 per cent.

tative analysis of the probable state-of-stress in the three joints tested is presented, and the effect of such states-of-stress on the fatigue strength is discussed. For both static and fatigue tests, the states of stress produced would be the same.

In the butt-joined specimens, an applied tensile stress would produce a tendency for the adhesive to contract in width in the plane perpendicular to the applied load due to Poisson's ratio. This contraction of the adhesive would be greatly curtailed because of the much greater stiffness of the aluminum parts. (The modulus of elasticity of the aluminum alloys in tension was about 10^7 psi and that of the adhesive about 10^5 psi.) This prevention of contraction of the adhesive probably generated radial shearing stresses between the adhesive and adherend which were resisted within the adhesive layer as radial and tangential tensile stresses. The stresses developed in the adhesive were probably very similar to the stresses developed in a solid metal specimen containing a deep circumferential notch.[8]

These stresses together with the axial tensile stresses produce a state of stress in which all three principal stresses are tensile stresses. Compression loads similarly produce a state of stress in which all three principal stresses are compression. Under such states of stress, the greatest principal shearing stress may have been small compared to the largest principal stress, whereas in the lap joints the largest shearing stress would have been approximately equal to the largest principal stress.

If the principal shearing stress is the controlling factor in fatigue of adhesives, the type specimen in which the principal shear stress was the smallest compared to the principal stresses would be the most resistant to fatigue.

Even though the tangential and radial stresses might approach the axial stress in magnitude at the center of the specimen, the radial tensile stress must be zero at the periphery of the joint. Thus the state of stress at the periphery will be different than at the center, and one would then need to know the location at which fatigue failure starts and the gradient of radial, tangential, and axial normal stresses in the joint to determine the stresses that cause failure. An examination of the fractured butt-joined specimens discloses that on one part of the periphery of each fracture there is a smooth area different from the remainder. This suggests a cleavage plane on which the fracture started, progressed slowly, and was polished by the repeated opening and closing of the crack.

In view of the above discussion it would seem difficult to test an adhesive in such a way that there was only one principal stress (simple tension). Possible methods which occur to the authors include: (1) testing a solid rod or film of adhesive; (2) selecting an adherend with a modulus of elasticity and Poisson's ratio about equal that of the adhesive; and (3) testing a series of specimens at successively smaller diameters and extrapolating the change in fatigue strength to a value for zero diameter, which should then be unaffected by the restraining action of the adherend.

The single-lap specimen was, by the nature of the joint, subjected to unsymmetrical loading, which with the thin plates used caused bending to take place in the vicinity of the joint in both plates. This action has been illustrated for rubber models by Jackson.[9] This bending introduced normal stresses in the adhesive, acting perpendicular to the plane of the joint, in addition to the shearing stresses. The normal stresses are highest near the ends of the overlap.

Normal stresses were introduced in the single-lap joint, not only because the two plates were curved by the bending moment so that under a tensile load their convex sides were in contact but also because the rotation of the joint as a whole placed it at an angle to the direction of the applied load.

As in the case of the butt joints, these normal stresses acting perpendicular to the plane of the adhesive probably produced a tendency for expansion or contraction of the adhesive in the plane of the joint which would be curtailed because of the much greater stiffness of the aluminum plates. This curtailment would probably cause normal stresses to be induced in the plane of the adhesive so that normal stresses in three directions and of the same sign were probably added to the shearing stresses in the joint.

The double-lap joints are symmetrical so that there is no tendency for rotation of the entire joint. Also bending of the cover plates resulting from the unsymmetrical load on them is less pronounced because of the support from the main plate and filler plate.

Thus, for equal loads per unit of area of the joint, the single-lap joint would have a lower shearing stress in the plane of the adhesive than the double-lap specimens because part of the load was used to produce the normal stress due to rotation of the single-lap joint. It also would have triaxial normal stresses superimposed on the shearing stress.

The single-lap specimens should, therefore, have greater fatigue strength than the double-lap specimens, as observed for the present fatigue tests.

The fact that the static strength of the lap joints was reversed in the present series of tests was probably due to factors discussed above. The general experience of the Chrysler laboratories as reported by D. L. Swayze indicates that the static strength of single-lap joints was greater than that of double-lap joints.

On the basis of these observations and tests, one would conclude that a double-lap specimen made from reasonably thick plates should be used when it is desired to obtain the fatigue strength of an adhesive under the state of stress called pure shear. Also, one would predict that single-lap joints made from thick plates would have less strength per unit area of the joint than those made from thin plates since less bending would occur in the thick plates with a resulting increase in the proportion of shearing component and a reduction in superimposed normal stresses.

Explanations which have been suggested by others for the lower strength of double-lap joints are unequal distribution of load and unequal strength of the two halves of the joint. These are probably contributing factors since the load distribution is determined by the accuracy of preparation of the specimens and test fixtures and variations in strength between halves of double-lap specimens cause the strength obtained for the joint to be always the strength of the weaker half.

Summary and Conclusions

1. The fatigue strength at 10^7 cycles of butt joints of a Cycleweld adhesive was found to be about three times the fatigue strength of double-lap specimens (1640 psi normal stress and 520 psi shearing stress, respectively) under axial loading with a mean stress of zero.

2. The fatigue strength of single-lap joints of the adhesive were found to be about 23 per cent greater than the double-lap specimens for the same loading conditions as in item 1.

3. The following suggestions have been advanced:

(*a*) The differences in fatigue strength noted above may be caused in part by differences in the state of combined stress existing in the three types of specimens.

(*b*) A butt-joint specimen can be made to yield data on the strength of the adhesive under the action of a single

[8] H. Neuber, "Theory of Notch Stresses: Principles for Exact Stress Calculation," *Translation No. 74*, David Taylor Model Basin, November, 1945, p. 88.

[9] C. C. Jackson, "Joints-Lap, Efficiency, Graphical Study of Physical Factors," Chrysler Engineering Laboratories, *Report. No. 4904*, February 1943. See also: R. C. Rinker and G. M. Kline, "Survey of Adhesives and Adhesion," NACA *Technical Note 989*, August, 1945.

principal stress (simple tension or compression) only by special procedures or special selection of the material of the adherend.

(c) The stress in the adhesive is more closely approximated by elementary formula in specimens of the double-lap type than in single-lap or butt-joined specimens.

Acknowledgment:

The project covered by this paper was part of the work of the Engineering Experiment Station of the University of Illinois, of which M. L. Enger was Director in the Department of Theoretical and Applied Mechanics, and of which F. B. Seely is the head. The authors wish to acknowledge the cooperation of D. L. Swayze, of the Chrysler Corp., who prepared the test specimens.

DISCUSSION

MR. A. G. H. DIETZ.[1]—Mr. Findley indicates that there seems to be some difference in the strength of double-lap joints and single-lap joints in his tests. He indicates that, generally speaking, a double lap gives a lower unit strength value than a single lap.

I should like to inquire whether that could not be explained by the fact that in a double-lap joint, one of the two is bound to be weaker than the other. In the case of adhesives the difference may be rather large, and when one of the joints fails, the entire assemblage will fail. Consequently the average of the two will be fairly low; whereas in any single-lap test, of course, the strength is the full strength of the lap. For example, the average of six single laps as compared to three double laps might be expected to be higher.

W. N. FINDLEY (*author's closure*).—In response to Mr. Dietz's question I agree that variations in strength between the two halves of a double-lap joint may be one of the causes of their lower strength compared to single-lap joints. The observed strength of a double-lap joint is probably equal to the strength of the weaker half rather than the average strength of the two halves. This would cause a lower average strength of several tests of double-lap joints compared to single-lap joints when there was a significant variation in strength. However, the discrepancy should decrease as variations in the quality of the individual joints decreased.

[1] Associate Professor of Structural Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

A Technique for Making Strain-Free Replicas for Electron Metallography

By William L. Grube[1] and Stanley R. Rouze[1]

IN GENERAL practice, Formvar[2] (polyvinyl formal) plastic replicas of metallographic surfaces are removed from the specimen by a method described by Schaefer.[3] In this method the dried replica is first moistened by condensing water vapor upon it and then picked up on a piece of scotch tape which has upon its adhesive side an electron microscope specimen screen. If the specimen being replicated is at all reluctant to release the cast replica, or if the microstructural detail of the specimen is relatively large with sharp discontinuities (for example, cemented carbides) Formvar replicas removed by the "dry-stripping" method exhibit "strain marks" as shown by the arrows in Fig. 1. These "strain marks" are exceedingly thin areas in the replica, presumably a result of stretching the plastic beyond its elastic limit. Although these "strain mark" artifacts are generally easily recognized, they sometimes are of such small magnitude, and the contrast between them and their surroundings is so slight, that their presence is not noticed until the micrograph is recorded on a photographic emulsion. Consequently, the time and material required for recording and developing the micrograph is lost.

The purpose of the investigation described in this paper was to develop a satisfactory procedure which does not subject the Formvar to undue stress and which will result in a strain-free replica.

EXPERIMENTAL

Another method sometimes used for removing plastic replicas from surfaces is to submerge the replica-covered specimen in water, "tease" up one edge of the replica with a sharp, pointed tool, and then pull the replica gently from the surface with tweezers while it is still submerged. Although good strain-free replicas can be obtained by this method occasionally, it is generally unsatisfactory because:

1. It is tedious.
2. If the surface being replicated is in the least hydrophobic, the water does not effectively loosen the replica.
3. Only small pieces of replica are obtained.

The yield of such a technique can be increased materially by first backing the thin Formvar replica with another plastic. Since this backing must be removed from the Formvar after the composite has been stripped from the specimen, it is necessary that this backing plastic be readily soluble in a solvent which does not dissolve the Formvar. These "backed" replicas are more easily removed and handled, chiefly because they are more rugged. Furthermore, there is less likelihood that the Formvar will be stressed excessively.

Trotter and McClean[4] have used such a "backing" technique, and the method to be described in detail is essentially a modification of theirs. The modifications are necessary for the following reasons:

1. Replica films which are to be shadow-cast must be mounted on the specimen screen so that the "structure" surface is on the side of the film away from, instead of on the side adjacent to, the screen.
2. Since thin films of Parlodion (the backing plastic) tend to curl and roll up when dry, methods for manipulating the backed replicas had to be devised.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Research Laboratories Div., General Motors Corp., Detroit, Mich.

[2] Formvar 15/95 "E" Marketed by Shawinigan Products Corp., New York, N. Y.

[3] V. J. Schaefer, "Dry Stripped Replicas for the Election Microscope," *Science*, Vol. 97, p. 188 (1943).

[4] J. Trotter and D. J. McClean, "Electron Microscope Study of Quenched and Tempered Steel," *Journal*, Iron and Steel Inst., Vol. 163, Part 1, p. 6 (1949).

The details of the method adopted as being satisfactory are as follows:

Upon removal from the etchant, the metal specimen is washed in hot water and immediately scrubbed, using a cotton swab, with a liquid soap, rinsed in hot water and dried in a blast of warm air. Without further delay, the surface is covered with a solution of Formvar in dioxane (0.5 to 1.0 per cent) and allowed to drain with the etched surface of the specimen in a vertical position. The film of Formvar remaining on the surface after evaporation of the dioxane protects the freshly etched surface from corrosion. When working with specimens that are apt to corrode easily, alcohol washes and rinses are substituted for the hot water washes and rinses above. Also, instead of drying the specimen after the final alcohol rinse, the alcohol is removed by flooding the specimen with the Formvar-in-dioxane solution. The protective film is thereby applied to the specimen without having exposed the freshly etched surface directly to the atmosphere.

When replicas are to be made, the specimen surface is held vertically and dioxane is allowed to run down the face of the specimen to remove the protective film of Formvar. (If the specimen does not corrode easily, the film may be removed by breathing upon it and direct stripping it with scotch tape.) When the protecting film has been removed, either by dissolution in dioxane or by direct stripping, the specimen surface is immediately flooded with a 0.3 to 0.5 per cent solution of Formvar in dioxane and allowed to drain with the face vertical. Somewhat better control over the drying process (evaporation of the dioxane) may be had by placing the specimen in a covered container on a thick filter pad (for example, Whatman ashless tablets) saturated with dioxane. This "atmosphere" drying decreases the evaporation rate of the dioxane and results in a thinner film when such is desired.

The replica film is then given a backing coat of Parlodion[5] (a 4 per cent solution in amyl acetate) and the specimen is drained with the replica covered surface at an angle of about 30 deg. with respect to the horizontal. The surplus solution is not removed but is allowed to build up at the lower end of the specimen and dry to a thicker film. "Zapon" lacquer as recommended by Austin and Schwartz[6] may also be used to back the Formvar replicas. This material has two marked advantages over Parlodion as a backing material: Zapon lacquer dries faster than the Parlodion-amyl acetate lacquer, and replicas backed with Zapon are invariably more easily freed from the specimen. There are, however, some disadvantages as will be noted later. When the backing film is dry, the composite film is cut through by scribing around the face with a razor blade. The specimen is then immersed in a dish containing distilled water.

After immersion, the thick end of the film is teased up with a needle in a convenient holder until it is free along the whole edge. This freed edge is then grasped with a pair of tweezers and the complete composite film is stripped away with an upward motion of the tweezers until only the far edge remains attached to the specimen. The freed film is then lowered back on the specimen by a downward motion of the tweezers and an upward motion of the specimen, the film being allowed to settle upon the surface from which it was stripped just as the specimen is breaking the surface of the water.

After removal from the water, the specimen is again immersed slowly at an angle, the loose side of the film first. The film then floats Parlodion-side-up on the water. In case the freed film is reluctant to float when the specimen is re-immersed in the water, the top surface of the film should be dried by touching the edge lightly with a filter paper. The edge of the film still fastened to the specimen may be broken by manipulation with a needle, or it may be cut with a pair of shears. The reason for not freeing the film completely under water is that, if the replica strip is narrow and the tweezers lose hold before the film is brought to the surface, it is apt to curl and twist about itself. If this happens, it is extremely difficult to untwist the composite film. The stripped film is allowed to float to the side of the dish where one edge is held while it is cut into small pieces approximately 1/8-in. square with a pair of small shears (small manicure shears having good register).

An alternate method for removing the composite replica film from the specimen may be used—especially if Zapon is used as the backing material. After the back-

[5] Purified cellulose nitrate marketed by Mallinckrodt Chemical Works, New York N. Y.

[6] A. E. Austin and C. M. Schwartz, "Modification of a Positive-Replica Technique for Electron Microscopy," *Journal of Applied Physics*, Vol. 22, No. 6, June, 1951, p. 847.

Fig. 1.—Formvar Replica, Dry-Rtripped, Cemented, Carbide Composition (×7500).

Fig. 2.—Formvar Replica Wet-Stripped, Cemented, Carbide Composition (×7500).

ing film of Zapon has been applied and before the specimen is immersed in water to loosen the film, the replica is scored into 1/8-in. squares with a razor blade. When the specimen is immersed in water, it will be found that the Zapon-backed replica squares, after a short time, are released from the specimen surface. Although the squares are effectively released by the water, they still remain in place on the specimen. These loosely adhering squares may then be brought to the surface individually and floated.

To mount the replica on an electron microscope screen, the floating pieces of composite film are captured on a ring brought up from below and, after raising the ring and film from the water, it is turned over. The film is then placed on a specimen screen supported by a small cylinder which will allow the ring to pass downward around it after the film has been deposited on the screen. The composite film is now Formvar-side-up on the 200-mesh specimen screen. The excess water remaining on the mounted film is removed by touching it with the edge of a piece of filter paper.

Sometimes, if the replica film is not centered on the ring when it is captured, it may be pulled off to one side when the ring is brought downward over the screen and the supporting cylinder. It will be found that the film is generally still attached to one side of the ring, in which case it may be refloated on water to be recaptured and centered on the ring. When the film is replaced on the water it will, unless it is twisted, invariably float Parlodion-side-up, no matter how it is placed back on the water. It should be noted that this is not always the case when Zapon is used as a backing. After re-floating the film, the process of mounting on a screen may then be repeated.

The transfer of the floating film from the water surface to the specimen screen is sometimes accomplished more conveniently by using a small annular-shaped piece of 100-mesh nickel screen instead of the ring. The mesh annulus is of sufficient outside diameter to prevent the corners of the film from folding under. The film, therefore, must lie flat on the mesh and there is less tendency for the film to be pulled off to one side as it is brought down over the specimen screen. The best tool to use (mesh-annulus or ring) depends upon the wishes of the operator.

The film, which is now Formvar and structure-surface-side-up, is lying upon, but not attached to, the screen. The film and screen are picked up by holding the two together at the edge of the screen with a pair of tweezers. At this point it will be noted that the corners of the film extend over the edge of the screen. If an entire edge of the film extends over the edge of the screen because the film was cut too large or because of improper centering, the edge should be trimmed away with a pair of small shears. The screen and film are now touched to the surface of amyl acetate in another dish. This partially dissolves the Parlodion backing, and upon lifting the screen and film from the surface the corners of the composite film will fold under the screen and hold the film on the screen. If all four corners do not fold under when the film is first lifted from the surface, the above process is repeated. The screen, with the film now securely attached, may then be set aside on a piece of filter paper and allowed to dry.

When all of the replica squares of a particular specimen have been mounted on screens, the mounts are placed upon a platform of 100-mesh nickel screen and then submerged in amyl acetate to dissolve the remaining Parlodion backing. Since the Parlodion dissolves more quickly in the screen openings than it does under the screen wires, it is not necessary to dissolve absolutely all of it. As soon as the backing film is dissolved away from the Formvar replica over the screen openings, the replica may be removed from the amyl acetate. The Parlodion remaining between the replica and the screen wires, after drying, effectively cements the replica to the screen. In order to insure that the replica will not be floated off the screen while it is submerged, it is recommended that a small brass ring 1/8 in. outside diameter by 3/32 in. inside diameter be placed over each replica before it is placed in the amyl acetate.

The technique described by Austin and Schwartz[6] for dissolving backing films from Formvar replicas may also be used to remove the Parlodion or Zapon backing. It is still advantageous to fasten the composite film to the screen at the corners as previously described. This is especially true if Zapon is used as a backing material since Zapon-backed films show a greater tendency to curl when dry than do Parlodion-backed films.

Complete dissolution of the Parlodion backing is accomplished in a period of 15 to 30 min. After removal from the amyl acetate, the replicas are washed briefly in a fresh amyl acetate bath and placed on a filter paper to dry. After drying is complete, the replicas are ready for shadow-casting or direct examination in the electron microscope.

Conclusions

We have found that Formvar replicas made by the procedure just described are nearly free of "strain marks" and that exceptionally thin replicas can be obtained successfully. A micrograph of a replica made using the above technique is shown in Fig. 2. Although this technique was first used for specimens of cemented carbide compositions, it can be used with equal success on practically all metal specimens.

Discussion of Paper on Calculation of Air Bubble Size Distribution from Results of a Rosiwal Traverse of Aerated Concrete[1]

Mr. R. E. Philleo[2] (*by letter*).—Lord and Willis have developed an ingenious, simple method for obtaining the bubble diameter distribution. The method, or parts of it, is also capable of yielding much additional information in a very simple manner.

In paragraph 14 the authors state that having obtained the sphere-diameter distribution it is possible to calculate any of the mean diameters of the system of spheres. As a matter of fact, it is possible to determine the mean diameters directly from the chord distribution without actually finding the diameter distribution. To find the diameter of the sphere having mean surface area or that of the sphere having mean volume, probably the two most useful of the mean diameters, it is not even necessary to have complete information of the chord distribution; only the fraction of the chords falling in the smallest size group must be known in addition to the normal Rosiwal traverse data consisting of total traverse length and the fraction of the traverse through air voids.

Equations for these quantities may be derived from previous work of Willis.[3] The square of the radius of sphere of average surface area, or second moment

[1] G. W. Lord and T. F. Willis, "Calculation of Air Bubble Size Distribution from Results of a Rosiwal Traverse of Aerated Concrete," ASTM Bulletin, No. 177, October, 1951, p. 56 (TP 220).

[2] Associate Research Engineer, Portland Cement Assn., Chicago, Ill.

[3] T. F. Willis, Discussion of a paper by T. C. Powers, "The Air Requirement of Frost Resistant Concrete," *Proceedings*, Highway Research Board, Vol. 29, pp. 203–211 (1949), Eqs. 56 and 57.

of sphere radii $[r]_2$ and the third moment of sphere radii $[r]_3$ may be expressed as follows:

$$[r]_2 = \frac{A}{\pi M}$$

$$[r]_3 = \frac{0.75A}{\pi M} = 0.75[r]_2[l]_1$$

where:

A = the number of chords per unit length of line,
M = AI (Fig. 5) = the number of spheres per unit volume, and
$[l]_1$ = the first moment, or arithmetic mean, of the chord lengths.

To find the arithmetic mean radius $[r]_1$ it is necessary to determine the first negative moment of the chords. Thus:

$$[r]_1 = \frac{A[l]_{-1}}{\pi M}$$

where $[l]_{-1}$ = the first negative moment or the reciprocal of the harmonic mean of the chords.

The following Table I shows the information that is easily obtainable from a modified Rosiwal traverse and the data required for each item.

It may be seen that the number of voids per unit volume can be determined more easily than the quantity of air. As more is learned of the importance of bubble size distribution, the number of voids per unit volume may become the more significant value. It is also apparent that the smallest size group yields more useful information than all the rest of the groups. Actually it is wiser to count the chords in the two smallest size groups than just the smallest and to use the result which gives the greatest number of voids per unit volume. As pointed out in the paper, the observer might fail to recognize and enumerate some of the shortest chords.

To illustrate both the ease of application of the Lord and Willis method and its agreement with another method developed by the writer, the following analysis of the data in the authors' Table I was carried out. The values on the left were obtained by plotting the chord distribution curve and integrating graphically two differential equations to obtain the sphere diameter distribution curve, while those on the right were obtained from formulas given above or in the paper using only the information shown below:

Total traverse length	284.34 cm
Length of traverse through air voids	14.78 cm
Smallest size group	0.001058 to 0.003174 cm
Total number of chords	−745
Number of chords in smallest group	−66

RESULTS

	Graphical Method	Simple Method
Number of voids	28,200 per cu cm	33,000 per cu cm
Diameter of bubble having mean surface area	10.22×10^{-3} cm	10.06×10^{-3} cm
Diameter of bubble having mean volume	15.22×10^{-3} cm	14.44×10^{-3} cm

MESSRS. LORD AND WILLIS (*authors' closure*).—Mr. Philleo's discussion makes a valuable complement of the paper. His tabulation of the specific quantities which must be measured in the Rosiwal traverse in order to calculate the various definitive characteristics of an air bubble system will be welcomed by analysts.

The authors are indebted to him for calling attention to the application of the disclosures of the current paper to the solution of the moment equations derived and previously published by Willis.[3] For this specific purpose the important contribution of our present paper is the method of obtaining an estimate of M, the number of bubbles per unit volume of specimen. This was the missing link which prevented full utilization of the original moment equations.

Being able to determine with a relatively small amount of work a few of the parameters characterizing an air bubble system should not blind one to the possible importance of bubble-diameter distribution. In the present state of our knowledge of the effect of the characteristics of such systems on the properties of concrete, we cannot say which is the more important. It should be noted that if one wishes to obtain the arithmetic mean bubble radius, all chords encountered must be measured and classified. When this has been done, calculation of bubble-diameter distribution is a relatively small additional chore.

TABLE I

Rosiwal Traverse Data[a]					Information Obtainable from Traverse Data
I	II	III	IV	V	
X	X	..	..	..	Per cent air
..	X	X	..	..	Specific surface of voids
X	..	..	X	..	Number of voids per unit volume
X	..	X	X	..	$[r]_2$; radius of sphere having mean surface area
X	X	..	X	..	$[r]_3$; radius of sphere having mean volume
X	..	X	X	X	Distribution of sphere diameters

[a] I = Total traverse length.
II = Length traversed through voids.
III = Total number of chords.
IV = Number of chords in smallest group.
V = Number of chords in each size group

Building Research Congress Meets in London

FIFTY nations were represented by 1300 engineers, architects, and builders at the Building Research Congress held in London, September 11–20.

Sessions were organized in three divisions: (1) design and construction methods, (2) materials, (3) acoustics, heating, air conditioning, and lighting.

Authors of papers in the materials group stressed the need for further research on materials and authors in all divisions underlined the importance of the research that brings forth the technical information which must precede the revision and modernization of antiquated codes, a problem that is faced in all countries. The lack in certain phases of adequate methods of testing and evaluating materials, constructions, and equipment was viewed as one of the most serious handicaps.

The papers are available in three volumes at a cost of $9.80, from the Organizing Secretary, Building Research Congress, 57 Onslow Gardens, South Kensington, London S.W. 7. The fourth volume, containing the discussions of the papers, is now in process of preparation.

Contour Mapping of Optical Surfaces with Light Waves

CONTOUR maps of precise optical surfaces, whose contour intervals are a small fraction of a wavelength of light, have been prepared in the Optical Instruments Laboratory of the National Bureau of Standards. By contrast, the usual contour map of a topographic surface may have contour intervals of several feet or more. The optical maps serve the same purpose as topographic maps, except that they reveal ridges and depressions measured in millionths of an inch rather than in feet or inches. For example, optical flats, which are quartz plates for calibrating the precision gages used by science and industry, must be flat within one five-millionth of an inch. Their surfaces must also be parallel to the same tolerance. The new maps can be used for checking the accuracy of these surfaces.

The maps are made by photographing the interference patterns that are formed when light waves are reflected from the surfaces of the specimen and a standard reference of known shape. In itself this is simple interferometry and is common practice in precision measurements of glass optical surfaces. The basic procedure, however, has been modified appreciably in the preparation of the new maps.

Excerpted from "The Public Library: Rampart for Freedom" by Luther H. Evans, Librarian of the Library of Congress.—Saturday Review of Literature, July 7, 1951.

Freedom of speech and freedom of the press we justly prize as among the inalienable rights of the individual. But it is upon the correlatives of these—freedom to hear and freedom to read—that all our other freedoms rest. For these are not only among the basic rights of society; they are among the necessary conditions of the existence of a free social order. The perpetuation of a free society requires not only that men have the legal right to hear and read the truth, to seek information from varied sources, to explore divergent views, to be exposed to new or heretical ideas but that they have the actual opportunity to do so. And the perpetuation of our cultural health similarly requires that men have not only the right but the means to encounter a wide variety of intellectual expression and to share with contemporary creators in the arts their fresh and emerging perceptions of the human experience. Free participation in the state exists only where there is free participation in information; the commonwealth of the human spirit is shared only so widely as the works in which it is embodied are shared.

Because books and those serious magazines that share their characteristics are the principal instruments by which man can extend his knowledge, correct his prejudices, enlarge and freshen his views, and broaden the range and depth of his cultural perceptions; because books are the principal means of keeping alive the sacred leaven of heresy, of opposing accepted error with unpopular truth, of giving a voice to the ignored and a forum to the oppressed; because they can intrude freshness and savor into the gelatinous uniformity of our cultural life—the means by which books are made realistically available to people are of the most profound social importance.

Even the smallest organization can still afford to publish a book or pamphlet. Both the specialized learned institution and the small committee with a "cause" find in the book their means of expression.

Moreover, books are the only general medium of communications under the control of the recipient. A man who wants to experience "Hamlet" may have to wait months or even years before he has a chance to see it on the screen or stage or television or hear it over the radio: but he can read it when he chooses. Though the educational potentialities of the other media are enormous, it is only by rare coincidence that a man impelled to find out something about nuclear fission or cancer control will be able to tune in on a program that will answer his questions; but if he has access to a good collection of books he can get immediately what he wants.

Modern Rôle of Independent Research

THE May issue of *Industrial Laboratories* Magazine carried a significant article entitled "The Independent Research Organization Today" by Raymond Stevens of Arthur D. Little, Inc. The article deals with the importance of independent laboratories in general, and points out the special significance of such organizations in time of national emergency. Mr. Stevens states in part:

"Consulting research laboratories are used primarily by companies with research and laboratory facilities of their own. The management of such firms, used to employing research as a strong right hand, need little urging to extend its usefulness by employing a consulting laboratory in special instances. Under the new economy these special instances are likely to occur with greater frequency and higher urgency.

"Just what is it the management of an industrial firm looks for when they look to the outside consultant? Primarily, perhaps, they expect the illuminating fresh approach to a problem in which their own research group has become involved to the point of submersion. Often, it is the special skill or special knowledge which makes the consultant indispensable to the further prosecution of a project. Management cannot afford the time under emergency conditions, where careful haste is the order of the day, to train a new expert in the research department in order to advance one particular phase of a project. Management knows, too, that a problem submitted to the outside specialist will have the benefit of the latter's experience in the whole field involved as well as his acute knowledge of the science. . . . .

"Again, technical knowledge rooted in various scientific fields can be brought to bear on the one research problem to help it along the road to speedy solution. . . .

"The consulting laboratory, too, owing to the very nature of its wider activities, can contribute a knowledge of the broad over-all technical and economic picture. . . .

"Personnel planning in the research departments of industry is found to become sketchier as research workers are drafted by the services, and the universities and technical schools find it difficult to supply the bright young graduates who might have taken their places. Here is an opportunity for the independent research laboratories, who will not be as incisively influenced as the industrial research department."

Fire Codes on Building Construction and Dust Explosion Prevention

THE National Fire Protection Association has recently issued Volume II, 1950 edition of the "Prevention of Dust Explosions," and Volume III, 1951 edition of "Building Construction and Equipment."

Dust explosions extending over a period of years have been responsible for a series of disasters involving large loss of life and property.

The list of explosions printed in this volume also include coal dust explosions in connection with coal pulverizing but does not cover dust explosions in mines. The present volume incorporates new and revised codes, adopted by the N.F.P.A., including changes on the fundamental principles for the prevention of dust explosions in industrial plants, additions to and rearrangement of the records of dust explosions, and revisions of country grain elevator, terminal grain elevator, and sulfur dust codes.

Volume III presents a compilation of N.F.P.A. Standards on building construction and equipment brought together in one volume. These standards should not be considered as building codes. The standards in this volume should be applied with due recognition of the fact that safe building construction and equipment *per se* may not be the complete answer to any individual fire problem and that the control or reduction of fire hazards, extinguishing, detection and alarm equipment, and other features should receive due consideration.

These codes are supplemented by various ASTM Standards which are found in various portions of the text. As a result of joint cooperation by the National Fire Protection Association, the American Standards Association, and ASTM, numerous fire tests have been approved as given in Part 8 of this book. This chapter refers to the Fire Tests of Building and Materials; Fire Tests of Door Assemblies; Fire Tests of Treated Wood Using either Fire Tube Method or Crib Method; and Fire Resistance Ratings which take into consideration heat transmission, structural stability under fire conditions, including the effect of expansion, and in certain tests the effect of hose streams applied during the course of a fire. In regard to the tests on treated wood the tests relate to the properties of treated wood as such, rather than to the performances of a fabrication used as an element of construction.

The volumes are priced at $3 and $4, respectively.

PROFESSIONAL CARDS

Commercial Testing and Research:

- Chemical
- Metallurgical
- Physical
- Radiographic
- Spectrographic
- Sampling

THE JAMES H. HERRON COMPANY

Engineers, Chemists, Metallurgists
Consulting, Inspecting, Testing
Physical, Chemical, Metallographic & X-Ray Laboratories
1360–1364 West Third St., Cleveland, Ohio

PATZIG TESTING LABORATORIES

ENGINEERING INSPECTION
TESTS • ANALYSIS • RESEARCH
—OF—
EQUIPMENT • APPLIANCES
MATERIALS & PRODUCTS
Ingersoll Ave. & 23rd St. Des Moines, Iowa

SMITH-EMERY COMPANY

Established 1910
Chemists — Engineers
Sampling, Analyzing, Assaying
Spectography, Physical Testing
Member: American Council of Commercial Laboratories
920 Santee St. Los Angeles 15, Calif.

SOUTHWESTERN LABORATORIES

Consulting, Analytical Chemists and Testing Engineers
Member A.C.C.L.
Inspections, Testing and Chemical Work
Fort Worth, Dallas, and Houston, Texas

Testing • Inspection • Consulting
Product Development & Research
United States Testing Company, Inc.
Hoboken, N. J.
Boston · Chicago · Denver · Los Angeles
Memphis · New York · Philadelphia · Woonsocket

BOWSER-MORNER TESTING LABORATORIES

Chemical—Metallurgical—Testing Engineers: Field and Laboratory Inspection and Tests—Chemical—Physical—Metallurgical—X-Ray—Diamond Coring—Environmental Testing.
135-143 Bruen St. P.O. Box 51,
Dayton 1, Ohio

W. B. COLEMAN & CO.

Metallurgists-Chemists-Engineers
Spectrographic Analysis
Chemical and Physical Testing
Metallurgical Investigations
Boiler Water Conditioning
Consultation Service
9th & Rising Sun Ave., Philadelphia 40, Pa.

ELECTRICAL TESTING LABORATORIES, INC.

Specializing in technical services to those intent upon **GOOD QUALITY**
2 East End Avenue *at* 79th St. New York 21 N.Y.

SOUTHERN LABORATORIES, INC.

Engineers — Chemists
Sub Soil Investigations
Physical, Chemical, and Soil Laboratories
Research & Inspection
Complete Model Shop
701 St. Michael St. Mobile, Alabama
907 Scanlan Bldg. Houston, Texas

ST. JOHN X-RAY LABORATORY

CALIFON, NEW JERSEY
COBALT 60
Phone: Califon 49

LEDOUX & COMPANY, INC.

Chemists, Assayers, Engineers
Samplers and Weighers
Spectroscopists
155 AVE. of the AMERICAS
NEW YORK 13, N. Y.

INDUSTRIAL X-RAY
TESTING — ANALYTICAL
METALLURGICAL — CERAMIC
RESEARCH — LABORATORIES
Centrally located in New England
J. DIRATS & CO., INC.
Notre Dame Street
Phone 2260 Westfield, Mass.

NATIONAL SPECTROGRAPHIC LABORATORIES, INC.

6300 Euclid Avenue Cleveland 3, Ohio
Specializing in Spectroscopy
Qualitative and Quantitative Analysis

SHILSTONE TESTING LABORATORY, INC.

Chemists & Engineers
Spectrographic Analyses*
New Orleans, La. *Houston, Tex.
Inspection at all leading industrial centers

The Oldest Commercial Laboratory In America
BOOTH, GARRETT & BLAIR

Established 1836
Analytical and Consulting Chemists
Samplers and Weighers
228 South Ninth Street Philadelphia 7, Pa.

PENNIMAN & BROWNE, INC.

Established 1896
CHEMISTS - ENGINEERS
Laboratory and Field Services
Inspection - Testing - Research
Member: American Council of Commercial Laboratories
341 ST. PAUL PLACE • BALTIMORE 2, MD.

Omaha Testing Laboratories

Chemists, Testing and Inspection Engineers
Testing, Inspection, Consultation, Design of all types of building and paving materials.
Investigation of Foundation Soils
511 South 20th St. Omaha 2, Nebraska

CHARLES C. KAWIN COMPANY

METALLURGICAL CHEMISTS
FOUNDRY AND METALLURGICAL ENGINEERS
METALLOGRAPHERS—SPECTROGRAPHERS
PHYSICAL TESTS
431 S. Dearborn St. Chicago 5, Ill.
110 Pearl St., Buffalo 2, N. Y.

FOSTER D. SNELL, INC.

RESEARCH LABORATORIES
29 W. 15th St. New York 11, N.Y.
WAtkins 4-8800
EVERY FORM OF CHEMICAL SERVICE

THE DETROIT TESTING LABORATORY, INC.

Established 1903
554 BAGLEY PHONE WO. 1-6520
DETROIT 26, MICH.

South Florida Test Service

Testing • Research • Engineers
Consultants and specialists in corrosion, weathering and sunlight testing.
4201 N. W. 7th Street, Miami 34, Fla. Established 1931
Member: American Council of Commercial Laboratories